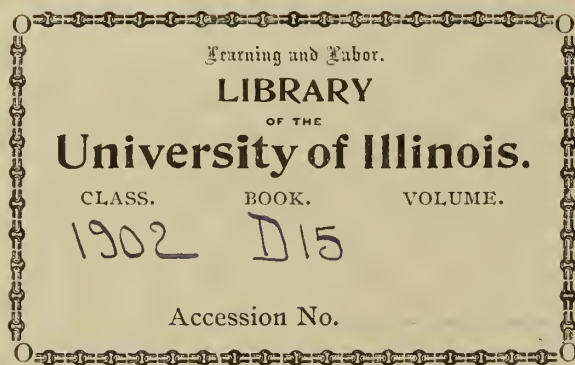


DALBEY

A Study of Cowpeas
And Soy Beans

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A Study of Cowpeas and Soy Beans

. BY .

DWIGHT STOUT DALBEY

THESIS

FOR THE

DEGREE OF BACHELOR OF SCIENCE

IN THE

COLLEGE OF AGRICULTURE

UNIVERSITY OF ILLINOIS

1902

A STUDY OF COWPEAS AND SOY BEANS
WITH REFERENCE TO THEIR
ADAPTABILITY TO ILLI-
NOIS CONDITIONS.

OUTLINE.

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A STUDY OF COWPEAS AND SOY BEANS
WITH REFERENCE TO THEIR
ADAPTABILITY TO ILLI-
NOIS CONDITIONS.

I. IMPORTANCE OF NITROGEN TO CROPS.

Nitrogen is one of the most important elements of plant food derived from the soil. It owes its importance to four conditions, viz.: (1) It is essential to plant growth, and is used in large amounts by plants; (2) it is the most expensive fertilizing element; (3) owing to its solubility, nitrogen is very unstable and cannot be fixed in the soil; (4) in most of our soils nitrogen exists in only limited quantities.

The soil of the corn belt of Illinois was originally very rich in nitrogen and very productive in crops, but loose, wasteful systems of farming, in which the plant food has been continuously sold from the land in the form of crops and nothing returned, has resulted in an exhaustion of the soil and a reduction of yields. This exhaustion cannot always be attributed

to the lack of available nitrogen in the soil, as there are so many different types of soils in Illinois, each having its individual weakness or strength, that the lacking element or elements may be Phosphorous, Potassium or Calcium. However, in many Illinois soils the decrease in yield of crops may be attributed to a lack of nitrogen, and it is partially for the solution of the nitrogen problem that this thesis is written.

II. LEGUMINOUS PLANTS AS NITROGEN GATHERERS.

The fact that plants of the Leguminous family fix atmospheric nitrogen by the symbiotic activity of micro-organisms is a development of recent years. The early experimenters came to the conclusion that the higher plants cannot assimilate the free nitrogen of the air. In 1837 Boussingault began numerous experiments with plants grown in sterilized soil, the plants themselves enclosed and sometimes surrounded with air free from nitrogen. At one time he held the opinion that nitrogen of the air was fixed in the soil by certain microscopic plants, but later abandoned this view, and finally, as the result of many years investigation concluded that the higher plants cannot assimilate the free nitrogen of the air.

Lawes and Gilbert began work on the problem about the time that Boussingault gave it up in 1857. They also grew plants in sterilized soil under glass covers, and like him reached the conclusion that plants do not take up the free nitrogen of the air.

The American chemist, Professor W. O. Atwater, was one of the first - probably the first - to publish the conclusion based upon experimental evidence that after all some plants do take up the free nitrogen from the atmosphere. He gives his data in detail, but makes no effort to explain how the nitrogen is taken up.

Probably the best known work demonstrating that free nitrogen is appropriated by leguminous plants is furnished by the German experimenters, Hellriegel and Wilfarth. The former, in 1883, grew various plants in washed sand, adding nutrient solutions but no nitrogen. Then to part of the pots he added a small quantity of combined nitrogen, and he found that the grasses grew in proportion to the amount of nitrogen added but that the legumes did not always agree. Certain legumes growing better than any of the others were found to have small tubercles on the roots. He then began to make soil extracts from rich garden soil which

he applied to certain plants under experiment. It was found that those treated responded with a good growth of plant with a development of tubercles on the roots. As a result of many such experiments, they announced in 1883 that "legumes thrive in soils without nitrogen, if only the tubercles are developed, but without the tubercles the growth is poor and no free nitrogen is taken from the air."

Lawes and Gilbert took up the study again in 1888 and in a year or two obtained results confirming those of Atwater and Hellriegel. In summing up the results of their work they write, "Reviewing the whole of the results which have been brought forward, there can be no doubt that the fact of fixation of free nitrogen in the growth of Leguminosae, under the influence of suitable microbe infection of the soil, and of the resulting nodule-formation on the roots, may be considered as fully established."

The importance of the conclusion reached by these men means a great deal to the Illinois farmer. Nitrogen in some form is very essential to the growth of plants, and is one of the most costly fertilizing materials, when supplied artificially. Yet by means of legumes there is an inexhaustible supply available to every farmer. He cannot draw on it with corn, wheat or oats,

but clover, cowpeas, soy beans and alfalfa acquire it and make it available for succeeding crops. In the light of this explanation the words of M. Georges Ville appeal to us more strongly: "It cannot be too often repeated that it is one of the secrets of profitable farming to draw from the air as much nitrogen as possible by the alternation of crops."

The cowpea and soy bean are both members of the family of leguminosae and compare favorably with the other legumes, clovers, alfalfa, vetch, etc., as renovators of the soil. Both plants are of tropical origin, but being quick maturing annuals, they are well adapted to the conditions of Illinois. The ideas incorporated in this thesis in regard to the practical growing of cowpeas and soy beans are the result of two years study and investigation of the characteristics of these crops as grown in Illinois. I have attempted to discover if cowpeas and soy beans are practical and profitable crops for the Illinois farmer to introduce into his crop rotation, and after some experience in growing them at Sibley in 1900 and last summer at my home farm and at the Experiment Station here, together with the practical points on their production gathered on several trips through southern Illinois and Missouri, coming in contact with some of the most successful growers of cowpeas and soy beans, I feel safe in

recommending these two legumes as crops worthy of a conspicuous place in the crop rotation of the Illinois farmer.

III. COWPEAS AND SOY BEANS.

Origin and History of the Cowpea. The cowpea, like corn, wheat and many other crops, is a plant of which we cannot be certain concerning its origin and early history. It is doubtless of Asiatic origin, though the original type has never been identified. DeCandolle, in his "Origin of Cultivated Plants", gives the origin of *dolichos sinensis* and *vigna catjang*; the former he assigns to India and tropical Africa and asserts that it is incontestably spontaneous in India and Java. The latter were found in earliest history in south-eastern Asia.

Botanists have not yet positively decided upon the exact position this plant occupies among plants. Neither its genera nor species have been unanimously agreed upon by botanists. *Dolichos sinensis*, *Dolichos lablab*, *vigue sinevsis* and *vigna catjang* are the names that the different botanists have used to designate the cowpea. There are as many as sixty varieties of the cowpea, which vary in their more noticeable characters. In all varieties the foliage, habits of growth, pods, seeds and botanical affinities are those of beans rather than peas.

Professor Brewer thinks it probable that most of our varieties belong to the species known to modern botanists as *vigna catjang*. Professor W. R. Dodson, botanist of the Louisiana Experiment Station, experimented with sixty-three so-called varieties of cowpeas with the special object of studying them from a botanical standpoint to see first whether they were included under more than one species and secondly whether they could not all be classified under one species. In his report he concludes from close study and comparison of growing varieties that there is but one species of all the varieties of true cowpeas and that the number of varieties can be greatly reduced. He regards the solid colors black, white and red as pure varieties and the others as fluctuating hybrids of these three. The Clay variety he says is possibly a degenerate red, but its constancy seems to be a character that would almost warrant a distinct variety. The name given by Professor Dodson to all our varieties of cowpeas is *vigna catjang*, and this name has been adopted by the United States Department of Agriculture.

DeCandolle states that the cowpea has been under cultivation in South eastern Asia for at least 3000 years. Owing to the entire lack of statistics it is impossible to know the exact time of their cultivation. In a letter from James W. Ragsdale,

United States Consul at Tientsin, China, he says that cowpeas have been grown from time immemorial. The cultivation probably commenced during the Chow Dynasty 200 years B.C.

We have no record of the introduction of cowpeas into the United States, but as it was quite common in South Carolina at the beginning of the 19th Century, it is probable that it was brought here from England by some of the earliest settlers of the country. It has been grown in the southern states principally up to this time, but gradually year by year the cowpea is becoming acclimated, so that it is being grown farther north each year, and last season cowpeas matured as far north as South Dakota and Wisconsin; so there is no question about the cowpea maturing in Illinois.

Origin and History of Soy Beans. The soy bean, known variously as *dolichos soja*, *glycine soja*, *soja hispida* and *glycine hispida* (all of which are names given to the same plant by different botanists), is a native of Japan. It has been found growing in the wild state in Japan and it has been cultivated by the inhabitants of this country from the remotest antiquity. The soy bean has been cultivated in Java and China for a long time, as a mealy substance called "shu" in Chinese writings of Confucius' time is supposed to have been made from

the seed of the soy bean.

The soy bean is undoubtedly indigenous to Japan and Java, and the inhabitants of these regions began to cultivate it at a very remote period, to use it as food in various ways and to obtain from it the various varieties of the present day. Owing to the fact that the origin of soy beans was in a colder climate than that of the cowpea, and also that they have been grown in northern climates to a greater extent than cowpeas, they are better adapted to the conditions of the north.

The cultivated plant differs from its wild progenitor chiefly in its more erect stem, larger legumes, and greater hairiness than the wild form. As grown in the United States, the soy bean is an erect growing plant, attaining a height of from 2 to 4 feet at maturity, depending upon the variety and soil. It has a stiff, woody stem and numerous branches which are thickly covered with pods, containing usually two to three beans in each. The foliage is heavy and the plants start to branch close to the ground, making a heavy, dense growth. In Japan the soy bean is extensively cultivated for human food, taking the place of beef on account of its richness in protein. The fodder is used as hay for stock.

The introduction of the soy bean into America has been within

the last twenty-five years, so it is not so extensively grown nor so well known as the cowpea and other legumes. Massachusetts and Connecticut have done more investigating with the soy bean than any other states, and it is largely to them that we are indebted for the present literature upon the subject. The Kansas Experiment Station has recently taken up the soy bean and has made it one of its most successful drouth-resistant crops.

IV. VARIETIES OF COWPEAS.

There are sixty or more varieties of cowpeas (*vigna catjang*), differing as to character of growth, amount of vine, yield of seed and time of maturity. papilionaceous plant with its organs of reproduction (stamens and pistils) tightly enclosed in a keel or membraneous envelope, so that self-pollination is forced. Yet there are so many varieties that it is a source of surprise, because, so far as known, there has been no attempt at artificially crossing the plant. Nevertheless, new varieties appear constantly and several more exist unnamed and undescribed. However, the large number of varieties may be partially accounted for by the fact that the same variety is quite frequently met with in widely separated portions of the country under many different

local names. So far as known, the cowpea nor soy bean have neither been bred nor selected to any type except color of seed; consequently, an immense number of variations are found in all the other characteristics.

The varieties known at present may be classified as to:

Habit of Growth.

Any grouping of varieties based upon habit of growth must be almost wholly arbitrary, as the character of growth and fruiting varies with a difference in soils or early or late planting. In the list below the varieties are grouped as a study of varietal characteristics warrants their growth on medium soil in Illinois.

(a) Trailing-Black, Everlasting, Couch, Coffee, Redeye, Indian, Large Red, Large White, Tory, Williams.

(b) Half Trailing-New Era, Red Ripper, Taylor, Vacuum, Chocolate, Calico, Congo, Granite, Gourd, Lady, Pony, Purple Hull Crowder, Rice, Shrimp, Sugar, White, White Brownhull.

(c) Erect. Unknown, Whippoorwill, Wonderful, Clay, Early Black Eye, Large Black Eye, Browneye, Speckled Crowder, Warren's Extra Early, Warren's New Hybrid.

When planted early on rich soil nearly all erect growing varieties assume, late in the season, a trailing habit, but when planted late or on a thin soil they remain bushy and erect.

Time of Maturity.

(a) Very Early: New Era, Extra Early Black Eye, Warren's Extra Early, Congo, Vacumn, White Giant, Chocolate.

(b) Early: Warren's New Hybrid, Whippoorwill, Red Crowder, Granite, Green, King.

(c) Medium: Coffee, Large Lady, Small Lady, Pony.

(d) Late: Black, Clay, Red Ripper, Couch, Unknown, Taylor, Wonderful, Calico, Black Eye, Everlasting, White Crowder, Purple Hull Crowder, Quadroon, Speckled Crowder, Rice.

Color of Pea.

(a) White: White, Black Eye, Lady, White Giant, Blue Hull, couch, Brown Eye, Large White, Pony, Purple Hull, Redeye, Rice, Small White, Sugar, Taylor, Vacumn, White Crowder.

(b) Buff: Clay, Warren's New Hybrid, Warren's Extra Early, Everlasting, Unknown.

(c) Pink and Red: Red Ripper, Colvin, Flat Red, Large Red, Pale Red, Purple Hull, Red, Red Crowder, Redding, Red Yellow Hull, Small Red, Tory.

(d) Mottled: New Era, Indian, Black and White, Calico, Chocolate, Coffee, Granite, King, Red Pod, Speckled Crowder,

Whippoorwill.

(e) Black: Black, Constitution, Congo, Shinny.

The varieties grown and best known in Illinois are Whippoorwill, Early Black Eye, New Era, Red Ripper, Unknown and Black, listed according to their relative distribution. The early and medium maturing varieties maturing in from sixty to ninety days are most popular and probably most practical for the Illinois farmer to grow.

VARIETIES OF SOY BEANS.

The soy bean (*glycine hispida*) has not been grown in this country long enough for very many varieties to have been introduced. From what I am able to learn through the consuls there are not a great many varieties grown in its native country, Japan. The varieties grown in the United States are distinguished according to the color and size of the seed, and time of maturity, with little variation in regard to character of growth.

The varieties grown in America are distinguished as to color:

Yellow: Early Yellow Dwarf, Medium Yellow, Late Yellow Mammoth.

Black: Medium Early Black, Medium Late Black.

Green: Medium Early Green, Late Green.

White: Early White.

The relative times of maturity of the varieties of soy beans are indicated by their names. The Early Yellow Dwarf is a large-seeded, yellow variety, while the Medium Yellow has much smaller seeds. The seeds of the black varieties are the largest of any variety grown here. The Department of Plant Distribution, Washington, D.C., has imported several green and black varieties from Japan which have given very good yields in Illinois and Kentucky. No names have been given these varieties, being simply designated by Nos. 4912, 4913, 4914, etc.

The Early White or Early Yellow Dwarf are excellent varieties to grow for an early crop of seed, but on account of the small size to which the plants grow and a tendency to drop the leaves early, these varieties are not so well adapted for soiling or hay.

The Medium Yellow or Medium Early Green are well adapted for hay, as they yield heavily of both seed and hay and retain their leaves well. For soiling or silage the Medium Early Black, or the Late Green, Black, or Mammoth varieties may be used according to the time of planting and the time at which the crop

is to be used. Where the crops are grown for seed, the early and medium maturing varieties are best to use in Illinois, as the later varieties rarely mature here.

V. CULTURE OF THE COWPEA.

All legumes require large amounts of the mineral elements of plant food, Phosphorus and Potassium, and it is necessary, first of all, that these elements should be present in an available form in the soil to grow either a crop of cowpeas or soy beans. The addition of nitrogen to the soil, where the proper bacteria were present, has been found to be of no practical use, as the yields resulting thereby have not been increased sufficiently to pay for the fertilizer thus applied.

The seed bed should be thoroughly prepared as for corn and plowed early in the spring and pulverized, so that the moisture will be conserved for the growing crop. One very successful grower of cowpeas in Illinois plows his land as soon in the spring as it becomes dry enough to work, then discs or harrows it often enough to compact and keep a mulch on top until the peas are planted. This conserves the moisture for the crop, which is one of the most important features of growing any crop, and

improves the physical texture of the soil.

Planting.

Since cowpeas are rather tropical in nature, they do best when the soil is well warmed, and as a very light frost will kill them, it is best to wait to plant until the seed bed has become thoroughly warmed up. Early planting promotes a luxuriant growth of vine, with consequent increased tendency for the vines to run and tangle, and often results in a decreased yield of seed. On the other hand, rather late planting tends to promote seed production and to reduce the growth of vine. So for our Illinois latitude, June 1st is early enough to plant cowpeas, and the earlier varieties will mature if planted as a catch crop after the oats are taken off in July. When planted in June, a longer time will be required to mature and of course a heavier crop will be produced. However, as much as ten bushels per acre has been threshed out of a crop sown after oats.

As to the method of planting, as regards distance apart for cowpeas, there is a great diversity of opinion among growers. Some farmers contend that cowpeas will not mature upon this rich, black soil of the corn belt, claiming that the growth all goes to vine rather than to seed. While it is true that cowpeas do



7 6 5 4 3 2 1
Plate I.

This cut shows cowpeas grown in washed, sterilized sand to which different elements and combinations of elements of plant food were added:

Pot 1 - No fertilizer.

" 2 - all elements but lime.

" 3 - " " " Nitrogen, Not Inoc.

" 4 - " " " " " Inoculated.

" 5 - " " " Phosphorus.

" 6 - all elements, " Potassium.

" 7 - all elements.

No. 4 shows the effects of inoculation over sterile soil (No. 3).

No. 2 (no lime) made fair growth but leaves had color at time cut was taken.

No. 5. (no P.) owes its inferiority to the low percent of P in cowpea seed, and No. 6. grew well on account of high content of seed in Potassium.



6 5 4 3 2 1
Plate II.

Cut showing soy beans grown in sand cultures. The same results were obtained with fertilizers on soy beans with the exception of the pot lacking Phosphorus. This pot made nearly as good growth as any of the pots, probably due to the high percent of Phosphorus in the seed.

grow more to vine on rich soils than on relatively poor soils, it is not true that the production of seed is lessened if the plants are far enough apart so as not to crowd one another. I have satisfied myself on this point by practical experience in growing cowpeas. In 1900, at Sibley, a very rich piece of blue grass pasture was broken up and planted to Whippoorwill cowpeas, drilling them in rows 30" apart and about 3" apart in row. The plants made a very heavy growth of vine and completely covered the spaces between the rows with a mat of vines, but a very large number of seed pods were also formed producing a yield of over 25 bushels per acre. On the other hand, the variety tests of cowpeas carried on by the Experiment Station here last year were planted in drills 16" apart on soil not as productive as the Sibley soil. As the plants began to grow and spread, the ground was soon covered and a dense mat of growing vines^{and} shading one another was the result. When time for harvesting came the only seed pods formed were on the edges where the plants had a chance to get some sunlight, and the best yields of seed we obtained off any of the plats was less than five bushels per acre.

Professor C. L. Newman, of the Arkansas Experiment Station, obtained some results in an experiment testing different amounts

of seed per acre that corroborate my theory in that respect. In a personal letter from Professor Newman he gave me the following results: "The cowpeas were drilled in rows 3-1/2 feet apart and the seed per acre varied from 12.5 lbs. to 100 lbs.

The results of my experiment are:

Pounds of seed per acre	: :No. of plants :to 100 ft.row	: :Weight of hay :per acre	: :Bu. peas :per acre
12.50	: 110	: 2675.	: 36.17
18.75	: 196	: 2320.	: 23.00
25.00	: 244	: 1825.	: 25.33
37.50	: 400	: 2120.	: 25.33
50.00	: 448	: 2187.	: 21.33
62.50	: 615	: 2007.	: 17.41
75.00	: 720	: 1733.	: 16.74
100.00	: 926	: 1966.	: 19.66

These results were so contrary to what was expected that Professor Newman repeated the experiment the next year with the following results:

Seed Per Acre	:	Yield of Hay Pounds.	:	Yield of Peas Bushels.
One peck	:	3314	:	31.4
Two pecks	:	3287	:	28.7
Three pecks	:	2641	:	28.3
Four pecks	:	2463	:	25.4
Six pecks	:	2111	:	20.1
Eight pecks	:	1749	:	16.4

The results of both experiments show that the lightest seed-
ing yielded the heaviest crop, both of seed and hay. This is
rather contrary to the way in which cowpeas are planted in
Illinois and indicates that most of our cowpeas are planted too
close on our rich, black soil. Cowpeas require lots of hot sun



Plate III

Field of Cowpeas, on farm of M. L. Poff,
O. Hwy., Ill. Cowpeas planted 32" apart.



Soy bean field on
farm of R. C. Morris,
O. Hwy., Ill.

Soy beans planted
in rows 32" apart with
New Superior drill.

Plate IV

and when planted close enough for one plant to shade another the production of seed seems to be hindered and the growth ~~and~~ ~~the growth~~ and development of vine stunted.

Some growers sow their seed broadcast and harrow it in, but this system has few qualities to recommend itself, since the yield of both seed and hay are much less and the waste of seed is tremendous, since it requires at least twice as much seed to get a stand that way as when drilled.

There are many kinds of planters used successfully in drilling cowpeas. Frequently the drill corn planter with small plates is used, making the rows 3-1/2 feet apart. Wheat drills which have a revolving plate instead of a force feed come into good use, as the flukes can be stopped up and only those allowed to run that will place the rows at the desired distance apart. For instance, in the New Superior Drill there are ten flukes 8 inches apart and by stopping up all the holes but the 1st, 5th and 9th the rows will be drilled 32 inches apart and three rows planted at one time. Another method which has been recommended is the four-row sugar beet drill, but this would plant the rows too close unless the distance could be adjusted.

In planting cowpeas or soybeans they should not be placed down at a great depth in the soil; if the soil is moist, 1 - 2

inches is deep enough.

Cultivation.

The time to do most of the cultivating of cowpeas is previous to the planting. The ground may be broken up early and disced or harrowed often enough to kill the weeds, so that when planting time comes the weed seed will have about all sprouted. After the peas come up a weeder or surface cultivator will be all that will be necessary to keep up the mulch on the surface until the plants get large enough to shade the ground. Care must be taken not to cultivate when the leaves are wet, as they are brittle and readily break off when they are damp.

CULTURE OF THE SOY BEAN.

The preparation of the seed bed and the time to plant soy beans are practically the same as for the cowpea, as both are very susceptible to cold and should not be planted before the soil is well warmed and there is no danger of frost. Since the soy bean has a stiff, erect growing stem, it will stand crowding a little more than the cowpea. However, soy beans should not be planted too close to cultivate, which would necessitate a dis-

tance apart of at least two feet between rows. The same implements used for planting cowpeas may be used for soy beans, changing the plates, of course, according to the size of the seed.

When planted for seed, soy beans should be planted far enough apart to allow of the perfect development of the plant and convenience in cultivation. For hay the plants should be thicker to prevent the stems from growing too coarse and woody.

Soy beans may be planted with corn either to be cut up with the corn as silage or left for sheep or hogs to pasture after the corn is husked. The photograph on next page shows a field of corn and soy beans on the farm of Dr. R. C. Morris, Olney, Illinois. The corn and beans were planted at the same time in alternate rows 2-1/2 feet apart and each were harvested separately with a Deering Corn Harvester. After curing, the corn and soy beans were shredded together and an excellent balanced feed produced.

Another method practiced by Delaware dairymen is to plant corn and soy beans in the same row together, first drilling the corn and then following in the same row and drilling the soy beans. This is harvested with a corn harvester and either made into silage or shredded after curing.

Plate V



Field of soy beans and corn on farm of Dr. R. E. Morris, Olney, Ill. The corn and beans were planted in alternate rows, 30" apart. Both were harvested, separately, with a Deering Corn Harvester, the bundles being ~~made~~ like the corn, a bundle of which is being held by person in middle.



Plate VII

Field of cowpeas and corn taken after
the corn had matured. Cowpeas planted
in same row with corn.

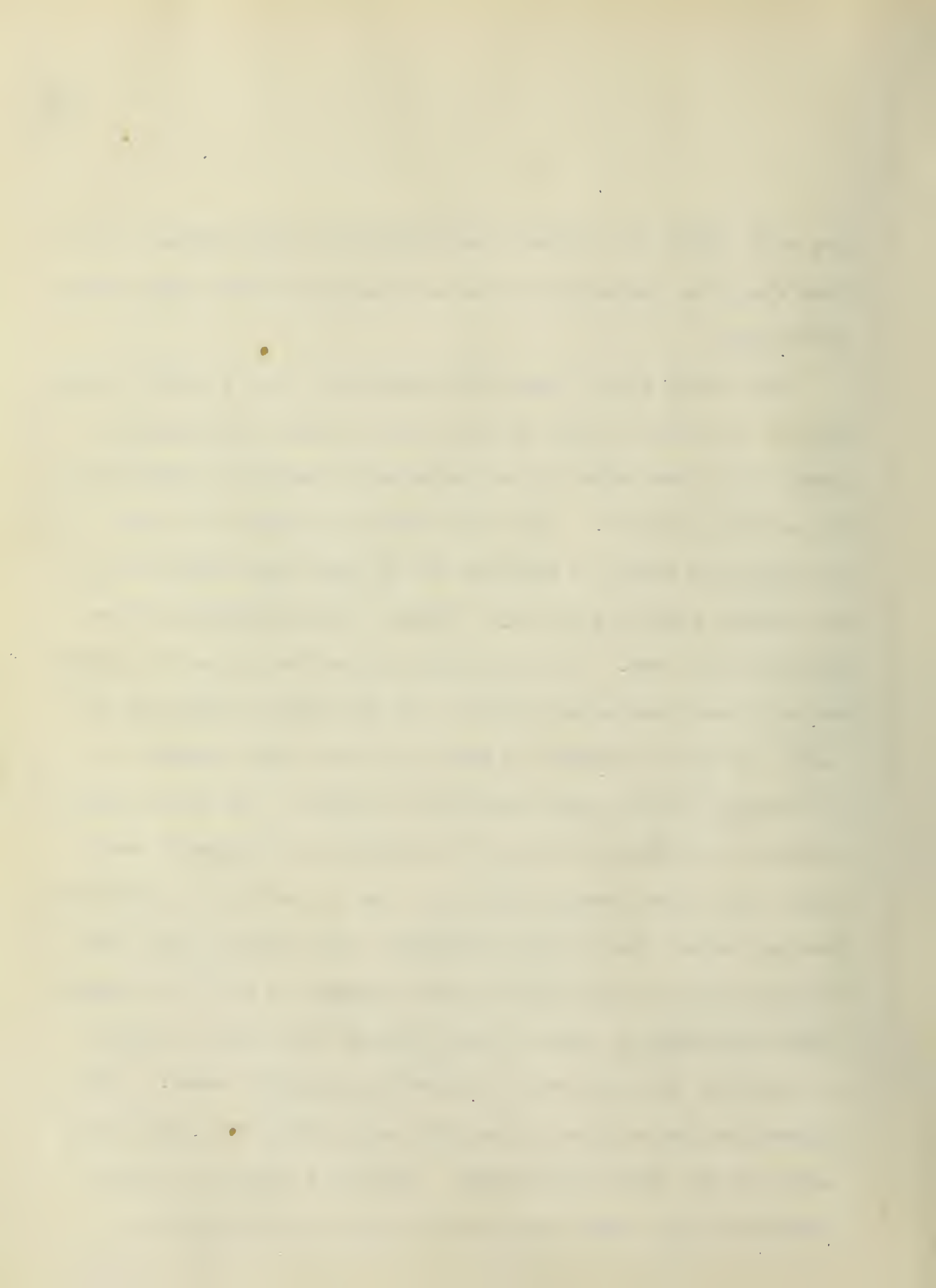
Soy beans are sometimes used as a catch crop with corn, sowing the beans as the corn is "laid by", or on wheat or oat stubble. Both cowpeas and soy beans are such excellent drouth resisting crops that they are well adapted to use as catch crops in the dry part of the year. The seed may be sown in corn either broadcast before the last cultivation or drilled with a one-horse wheat drill, planting one or two rows in each middle. The success or failure of this practice depends upon the season. If there is a lack of moisture in the soil as there was last year, to bring up the beans, or if early frosts come in the fall, the growth will not amount to much. Two years ago at Sibley cowpeas broadcasted ahead of the last cultivation was very successful, as the fall was late enough to allow the peas to grow after the corn had matured and let in the sun-light.

VI. Harvesting.

The proper stage for harvesting cowpeas or soy beans depends upon the use to which the crops are to be put. Experiments show that for hay soy beans should be cut when in bloom, as if cut later some of the leaves, which are the most nutritious part of the plant, will be lost, and the stems will have become coarse and impalatable. Cowpeas should be mowed for hay when the peas

are well formed and the pods are beginning to turn yellow. At that stage the leaves are all on and the peas are not ripe enough to shatter.

The curing of soy beans and cowpeas for hay is quite a task, more so even than clover, as the vines are more succulent and green than clover when cut and necessarily require a longer time to cure out properly. The main problem in curing is to get the vines dry enough to keep and at the same time retain all of the leaves, which are the most valuable and nutritious part of the plant for feed. In the curing process the leaves of cowpeas and soy beans become very brittle and are easily broken off and lost; so it is necessary to keep the leaves from exposure to the hot sun, as they are the first to wither. One of the most successful methods of curing is to shock up the vines in small cocks, soon after mowing, and allow them to cure out in the shock. Another method, that is very successful with clover, and I see no reason why it would not work with cowpeas as well, is to use a side-delivery hay rake and keep the hay revolving as fast as it dries out until the whole windrow is uniformly cured. This exposes the whole plant to the wind and is much more rapid process than any other recommended. Where the medium or mammoth varieties of soy beans are used they may be very successfully



harvested with a corn harvester and allowed to cur in shocks like wheat or oats.

Harvesting for seed.

When the crops are left for seed, cowpeas and soy beans should be cut a little before they are fully ripe, as if left until the beans or peas become thoroughly matured the pods will open and the beans will shatter badly. As soon as cut the vines should be raked up in windrows and shocked and left to dry out in the shock. It is necessary that the seed become thoroughly dry before threshing as a little dampness in the seed when stored causes them to heat and lose their vitality.

Threshing of soy beans may be done with an ordinary grain separator, using all blank concaves and running slow enough as not to crack the beans. Cowpeas cannot be successfully threshed with the grain separator, owing to the readiness with which they crack. A special bean and pea thresher is manufactured by the Bidwell Thresher Company of Batavia, New York, which has given satisfaction in southern Illinois.

The most satisfactory way found for harvesting the crops of cowpeas and soy beans is to cut off the plants just beneath the

surface of the ground and rake into windrows. There are special bean harvesters on the market which have two blades set diagonally so as to cut off two rows at a time. The Kansas Experiment Station has used a two-horse cultivator with the shovels removed and a horizontal knife about 18 inches long bolted to the inner shank of each beam set out from the cultivator and sloping backwards from the attachment to the point so as not to clog. This device cuts two rows at a time and has given satisfactory results in Kansas.

VII. Inoculation of the Soil for Cowpeas and Soy Beans.

The presence of the right species of bacteria in the soil is necessary for the production of tubercles upon legumes, and ultimately for the fixation of the atmospheric nitrogen in the soil. It is pretty conclusively proven, at least in the minds of bacteriologists, that each species of legume must have a certain species of bacteria, through the activity of which the tubercles are formed. When cowpeas or soy beans are planted on a soil for the first time very rarely are tubercles found in any abundance, and often none can be found whatever. Where there is any indication of the presence of the proper species of bacteria,

the second crop on that soil usually produces an abundance of tubercles, showing that the few micro-organisms must have multiplied very rapidly during the year. If there are no bacteria present, the growing of legumes will make as heavy demands on the soil for nitrogen as any gramineous crop; so it is necessary in any sterile soil to introduce the bacteria by some means of inoculation. The illustration on next page shows the effect of inoculation on the growth of the plant. These plants are cowpeas and soy beans grown in washed, sterilized sand, to which all the essential elements of plant food were added except nitrogen, and to two of the pots (one cowpea and one soy bean) was added the bacteria in solution. The results are seen by comparing the growth of the inoculated pots with those not inoculated. The same experiment was carried on last winter with cowpeas alone, in which the seed was analyzed and the per cent of nitrogen taken by the inoculated plants calculated. The results are:

	Inoculated Pot	Not Inoculated
Total N. in plant	67.73 mgs.	4.48 mgs.
Total N. in seed and soil extract	<u>9.1 "</u>	<u>7.79 "</u>
Gain or loss N.	+58.63 mgs.	-3.31 mgs.
Percent gain or loss	644.28 % gain	43.6% loss



1

2

3

4

1 and 2. - Cowpea and soy bean grown in inoculated sand.

3 and 4. Not inoculated.

From these results the necessity of the bacteria is apparent since the pots that were inoculated made an increase of 644.28% of nitrogen, while the plants without the bacteria actually lost part of the nitrogen planted in the seed.

Where inoculation is necessary probably the most satisfactory and cheapest method is to get soil from a field where tubercles have been formed and sow the soil as the seed is planted. A drill with fertilizer attachment may be used and the soil drilled into the furrows with the seed.

It is pretty well proven, however, that most Illinois soil contains the proper species of bacteria for cowpeas and soy beans, if only in small numbers, as tubercles develop both on cowpeas and soy beans where these crops are grown for a year or two without inoculation. Professor Scovell of the Kentucky Experiment Station found that soil which showed no tubercles in 1900 produced an abundance of tubercles in 1901; so the bacteria were either dormant and few in number, or else the soil was inoculated accidentally through the seed. So, in the light of what has already been done in this and other states without inoculation, it seems that the extra expense of that operation would not be warranted.

VIII. THE FERTILIZING VALUE OF COWPEAS AND SOY BEANS.

Legumes owe their value as fertilizers partly to the fact that they have, through their symbiotic relation to certain bacteria, the power of drawing upon the atmospheric nitrogen instead of taking it from the soil, and partly to their very extensive and deeply penetrating root system, together with a tendency to thrive on poor soils, which enables them to bring the plant food of the subsoil into the feeding ground of the graminaceous crops.

Cowpeas and soy beans possess this ability to rustle for plant food to a greater extent than the other members of the leguminous family; consequently, they are more valuable to increase the nitrogen content of badly worn-out soils. These two legumes also improve the physical texture of the soil, as a result of their extensive root system.

Compared with clover as a fertilizer, cowpeas and soy beans have the advantage in their favor, because they are quick maturing annuals and can be sown as a catch crop with or after another crop and will frequently mature in 60 days, while clover is a slow growing biennial plant and will not make much growth in less than 15 months after planting. Clover is also very



Plate VII

Cut showing soy bean root development.
Roots penetrated over four feet deep

susceptible to heat and drouth, and very often the farmer fails to get a stand on this account. Cowpeas and soy beans will thrive in almost any drouth after the plants get a start. Last summer during the hottest and driest part of August I made a trip through central and southern Illinois and the cowpeas and soy beans were the only prosperous looking crops that could be seen. Let us take a rotation commonly practiced in Illinois,

corn

oats

wheat

corn,

and see how the cowpea or soy bean can be grown with these crops so that each year the soil will produce a money crop and the nitrogen content maintained.

As the corn is laid by, cowpeas or soy beans, preferably the former, may be sown, and on an average season will make a good growth that fall. Then these vines are turned under in the spring and the ground sown to oats, and as soon as the oats are taken off cowpeas may be sown in July, having plenty of time for the early varieties to mature before the wheat is sown in the fall. The wheat next year can be succeeded by a catch crop of cowpeas and in this way each grain crop alternates with a

leguminous crop. In a rotation which is more common in this part of the state, corn, oats, corn, or simply corn, corn, corn, the catch crop could still be grown each year. Of course this system is very intensive and would require additions of manure or commercial fertilizers to maintain the mineral elements of the soil. However, this system of rotation would keep up the nitrogen content which is the most expensive element to replace in the form of commercial fertilizers.



Plate VIII

Soy bean root nodule

Probably the most practical and profitable method of maintaining the fertility of our soil is to feed the crops and return the manure to the soil as in that way there is very little loss of soil fertility.

The Arkansas Experiment Station has carried on quite an extensive series of experiments testing the effects of cowpeas upon succeeding crops, with the following results:

EFFECTS OF DIFFERENT PRECEDING CROP ON YIELD OF CORN.

Yield of corn on corn land	24.2 bu. per acre
" " " " cowpea stubble after oats	37.2 " " "
" " " " corn (and cowpeas in corn) land	34.6 " " "
" " " " cowpea vines turned under	39.7 " " "

FERTILIZING EFFECTS OF COWPEAS ON OATS.

Oats following corn	24.63 bu. per acre
" " sorghum	20.84 " " "
" " cowpea vines turned under	38.80 " " "
" " soy bean " " "	35.18 " " "
" " cowpeas between oat crops	33.69 " " "
" fertilized with 400 lbs. complete fertilizer	29.40 " " "

FERTILIZING EFFECTS OF COWPEA AND SOY BEAN STUBBLE UPON
WHEAT AS COMPARED WITH WHOLE LEGUME PLANT.

					Bu.wheat per acre	Tons hay per acre
Plat 1.	Wheat following wheat stubble				9.8	
" 2.	" " cowpea "				15.8	3-1/4
" 3.	" " " vines				11.4	
" 4.	" " soy bean stubble				14.9	4-1/2
" 5.	" " " " vines				12.3	

THE FERTILIZING VALUE OF COWPEA STUBBLE UPON OATS AS
COMPARED WITH THE WHOLE COWPEA PLANT.

Oats after oats					23.18 bu. per acre
" " " and cowpea stubble					31.24 " " "
" " " " " vines					39.87 " " "

These results show that plowing under cowpea as well as soy bean stubble gives better returns than turning under the whole plant. With oats the results are reversed and greater yields are obtained by turning under the vines. This difference is explained by the fact that wheat is planted soon after the cowpea

vines are plowed under, and the gases liberated by the fermentation of the green vines has an injurious effect upon the young wheat plants. Since the corn and oats are not planted until the following spring, this fermentation is completed and the crops get the advantage of the added plant food of the decayed vines.

However, there is another aspect to plowing under the vines as a green manure. While turning under the vines produces greater yields in the succeeding crop than cutting off the vines for hay and simply turning under the stubble, yet from the standpoint of financial returns the best disposition of the cowpea or soy bean crop is to feed the hay and return the manure to the soil. This brings us to the feeding of cowpeas and soy beans which will be treated in the next topic.

IX. FEEDING OF COWPEAS AND SOY BEANS.

Aside from their great fertilizing value, cowpeas also possess a greater value as a feed for stock. These two legumes have an advantage over clover as far as a feed is concerned in the fact that they produce a heavy crop of seed as well as hay, and the feeding value of this seed is equal to that of our most

concentrated feed stuffs.

As a proof of the nutritive value of cowpeas and soy beans let us compare their composition with that of some of our more important feed stuffs used by Illinois feeders.

The following table showing composition of food stuffs is compiled from Henry's "Feeds and Feeding", and the money values of the different constituents, protein, carbohydrates and fat are those assigned by F. D. Coburn, Secretary of the Kansas State Board of Agriculture. The values assigned, according to Mr. Coburn, are:

Protein	3.37	cents	per	pound.
Carbohydrates	.32	"	"	"
Fat	.56	"	"	"

COMPOSITION AND RELATIVE MONEY VALUES OF FEEDING STUFFS.

Name of Feed	: Digestible Nutrients in 100 : Lbs.	: Total Value of Di- : gestible Nutrients : in 100 Lbs.
	: Protein : Carbohydrates : Fat:	
Corn	: 7.8 : 66.7 : 4.3:	\$.50
Soy Bean Grain	: 29.6 : 22.3 : 14.4:	1.15
Cowpea Grain	: 18.3 : 54.2 : 1.1:	.796
Wheat Grain	: 10.2 : 69.2 : 1.7:	.575
Gluten Meal	: 25.8 : 43.3 : 11. :	1.07
Linseed Meal O.P.	: 29.3 : 32.7 : 7. :	1.13
Soy Bean Hay	: 10.8 : 38.7 : 1.5:	.496
Cowpea Hay	: 10.8 : 38.6 : 1.1:	.494
Clover Hay	: 6.8 : 35.8 : 1.7:	.354
Alfalfa Hay	: 11. : 39.6 : 1.2:	.505
Soy Bean Straw	: 2.3 : 40. : 1. :	.212
Cowpea Straw	: 4.3 : 32.3 : .8:	.252
Oat Straw	: 1.2 : 38.6 : .8:	.168
Corn Stover	: 1.7 : 32.4 : .7:	.165

A comparison of the digestible nutrients in 100 pounds of soy beans, either of the hay, grain or straw, shows the superiority of that feed over all others. Even linseed meal is less than half as rich in fat and .3% less in protein than soy bean grain. The cowpea grain is not so concentrated a feed, but is 50% more valuable than corn, pound for pound.

Soy beans and cowpeas compare favorably with other feeds as producers of nutritious digestible matter per acre. As a proof of this, let us estimate the average amount of dry matter and digestible nutrients per acre which are produced by some of the more important Illinois plants that can be used as stock feed.

The composition of the different feeds given in the following table is taken from Henry's "Feed and Feeding", and the yields of the different crops estimated as average yields.

ESTIMATED DRY MATTER AND DIGESTIBLE NUTRIENTS PER ACRE.

Crop	:Yield	: Amount	: Lbs.	: Dry	: Digestible Nutrients		
	: Per Acre			: Matter:			
					:Protein:	:Carbohydrates:	:Fat
Corn	:Grain	: 50 bu.	:2800	: 2503	: 218	: 1867	:120
	:Stover:		:5000	: 2975	: 85	: 1620	: 35
Total				: 5478	: 303	: 3487	:155
Wheat	:Grain	: 20 bu.	:1200	: 1074	: 122	: 830	: 20
	:Straw		:1000	: 904	: 4	: 363	: 4
Total				: 1978	: 126	: 1193	: 24
Oats	:Grain	: 35 bu.	:1120	: 996	: 103	: 529	: 47
	:Straw		:1500	: 1362	: 18	: 579	: 12
Total				: 2358	: 121	: 1108	: 59
Cowpeas	:Grain	: 20 bu.	:1200	: 1022	: 219	: 650	: 14
	:Straw	:2-1/2 tons	:5000	: 4320	: 215	: 1615	: 40
Total				: 5342	: 434	: 2265	: 54
Soy Beans	:Grain	: 25 bu.	:1500	: 1338	: 444	: 334	:216
	:Straw	:2-1/2 tons	:5000	: 4495	: 115	: 2000	: 50
Total				: 5833	: 559	: 2334	:266
Red Clover		: 2 tons	:4000	: 1168	: 116	: 592	: 28
Alfalfa		: 5 tons	:10000	: 2820	: 390	: 1270	: 50
Rape		: 15 tons	:30000	: 5600	: 450	: 2430	: 60

This table shows at a glance the superiority of soy beans as a feed for stock. In the first place, the soy bean yields more dry matter, more digestible protein and fat than any other crop, if the yields given to the different crops are comparable.

The yield of soy beans per acre is 75% more digestible protein and over 60% more digestible fat than corn. The cowpea yields 40% more ^{protein,} but 33% less fat than corn, showing that fat of cowpeas is much lower than that of soy beans. In carbohydrates however the cowpea and soy bean are both very low, the former yielding 30% and the latter 31% less per acre in that constituent than corn. This indicates that corn and soy beans or corn and cowpeas would blend very well together to balance a feeding ration, since one feed is rich in the constituent which the other lacks, and since corn is our chief crop in central Illinois, and the cheapest source of the carbohydrates for feeding, so soy beans are the cheapest source of the protein and fat of our feeding rations, and the two feeds are complements of one another to make a balanced ration.

The feeding value of soy beans and cowpeas does not exist on paper alone. Actual feeding experiments give results that are as convincing as the tables of composition. The Kansas

Experiment Station obtained the following results in an experiment in which one lot of pigs were fed on corn meal alone, and the other lot on a mixture of two-thirds corn meal and one-third soy bean meal;

	: : Average gain : per hog :	: : Gain per bu. : of feed :	: : Feed per 100 : lbs. gain :
Lot I. Corn meal	: : 82.6 lbs. :	: : 11.6 lbs. :	: : 484 :
Lot II. Corn meal two-thirds: Soy bean meal one- third	: : 120.4 lbs. : : 369 :	: : 15.5 lbs. : : :	: : : : :

showing a saving in amount of feed required to make 100 lbs. gain of twenty-four per cent by adding soy beans to the corn. The Kansas Station fed another lot of hogs on Kaffir corn meal and soy bean meal with the following results:

	: : Average gain : per hog :	: : Gain per bu. : of feed :	: : Feed per 100 : lbs. gain :
Lot I Kaffir corn meal	: : 52.4 lbs. :	: : 7.5 lbs. :	: : 749 lbs. :
Lot II. Kaf.cormmeal: 4/5;soy bean meal 1/5:	: : 97.8 lbs. :	: : 12.1 lbs. :	: : 468 lbs. :

This experiment shows a saving by adding soy beans to the Kaffir corn of over thirty-seven per cent.

Mr. C. A. Rowe, of Jacksonville, Illinois, has kindly given me the results of a very careful experiment with pasturing pigs on soy beans last fall. The pigs were turned in and allowed to "hog down" the beans after they were ripened, and in addition to the beans some corn was fed to the pigs. Mr. Rowe gives the following figures and results of his experiment:

On Sept. 11, 132 pigs turned in, weighing	10180 lbs.
On Oct. 7, 132 pigs turned out, weighing	14366 "
Gain	4186 "
Gain per day each	1.25 lbs.
108.65 bu. corn fed during time and allowing	
10 lbs. pork for each bu. corn	1086 lbs.
Subtracting 1086 from total gain of 4186 lbs.,	
the shoats gained on beans 3100 lbs.,	
amounting to 647 lbs. of pork per acre,	
which at present price of pork, 6 cents	
per pound, amounts to \$38.82 per acre.	

Cowpeas have also been found to be a valuable adjunct to feed with corn. The Alabama Station¹ made an experiment with

¹Alabama Bulletin No. 82.

three lots of pigs, feeding respectively corn, cowpeas and a mixture of the two for sixteen weeks with the following results:

	: : Average : Wt. at : Beginning:	: : Feed : Eaten : Lbs.	: : Gain : Lbs.	: : Feed : for 100 : Gain
Lot 1. Corn	: : 58	: : 844	: : 173	: : 487
Lot 2. Cowpeas	: : 60	: : 954	: : 198	: : 481
Lot 3. 1/2 corn and 1/2 cowpeas	: : 62	: : 909	: : 210	: : 433

These results show that cowpeas alone give greater gains in feeding pigs than corn alone, but that a mixture of one half of each gives results much superior to either alone.

The South Carolina Station has deducted from a series of experiments with feeding cowpeas to pigs that it requires 4.91 lbs. of cowpeas to produce one lb. of pork. At this rate one bushel of cowpeas would produce 12.2 pounds of pork, or one acre yielding 20 bushels would produce 244 lbs. of pork, which at 6 cents per pound would be \$14.64 per acre on cowpeas alone.

The Alabama Station carried on an experiment with two lots of pigs: one on corn alone and the other on corn and cowpea pasturage, with the following results:

CORN VS. COWPEA PASTURAGE AND CORN.

	: Gain - Lbs.	: Pounds : corn eaten	: Pounds corn : per lb. gain
Lot 1. Corn alone	: 45.2	: 263.8	: 5.86
Lot 2. Corn and cowpea pasturage	: 122	: 374.	: 3.07

According to these results hogs on cowpea pasture and corn not only make larger gains, but a larger consumption of corn is induced than when fed on corn alone, showing that the feeding value of the cowpea itself is not so great as when combined with corn; which is another argument in favor of growing cowpeas and soy beans in the Illinois corn belt.

The results given thus far have been the results of experiments with hogs, but cowpeas and soy beans give equally as good results with cattle. Professor Waters of the Missouri Experiment Station carried on several experiments, comparing different roughness for fattening steers, with these results:

COMPARISON OF DIFFERENT ROUGHNESS FOR FATTENING STEERS IN WINTER,

JAN. 6, '01 - APR. 16, '01 (105 DAYS).

Kind of Feed	: Bu.	: Lbs.	: Total	: Av. Daily	: Lbs.	: Gain
	: Corn	: Roughness	: Gain	: Gain Per	: Grain Per	: Per Bu. of
	: Eaten	: Eaten	: Lbs.	: Steer.	: Lb. Gain	: Corn
	:	:	:	: Lbs.	:	: Lbs.
Corn and Timothy hay	: 157.5	: 2540	: 789	: 1.97	: 11.19	: 5.
Corn and Clover hay	: 176.2	: 4768	: 1135	: 2.84	: 8.69	: 6.44
Corn and Cowpea hay	: 175.3	: 4783	: 1134	: 2.84	: 8.65	: 6.47
Corn, clover and corn fodder	: 176.2	: 2475	: 1140	: 2.85	: 8.30	: 6.74

The results of this experiment show that clover and cowpea hay are practically equal, pound for pound, but timothy is much inferior to either, as a roughness to feed with corn to fattening cattle.

Professor Waters carried on an experiment with the same feeds for wintering stock cattle with these results:

EXPERIMENTS WITH DIFFERENT RATIONS FOR WINTERING YEARLING STEERS.

DEC. 29, 1899 - APRIL 9, 1900 (104 DAYS).

Kind of Roughness	: :Corn Eaten : Bu.	: : Roughness: : Eaten. Lbs:	: :Total Gain : Lbs.	: : Average : Daily Gain : Lbs.
Timothy hay	: 28	: 6536	: 260	: .64
Clover hay and corn fodder	: 28	: *3593 : †3631	: 356	: .88
Cowpea hay	: 28	: 7757	: 624	: 1.54
Cowpea hay (no grain)	:	: 8048	: 228	: .56

*Clover hay

†Corn fodder

From these results the feeding value of cowpea hay as a part ration with corn is apparent. Both for fattening and wintering cattle, cowpea hay gives equal returns, pound for pound, with clover hay, and since nearly twice as much cowpea hay is usually produced on an acre as of clover hay, it is apparent that cowpeas should supersede clover to some extent as a feed.

X. SUMMARY.

1. Cowpeas and soy beans compare favorably with clover as soil renovators, and possess an advantage over clover in being quick maturing annuals, thus making it possible to secure a leguminous catch crop where clover would be impracticable.

2. Cowpeas and soy beans produce large yields of both hay and grain, the former being equal in feeding value to clover hay and the latter one of the most concentrated feed stuffs for stock.

3. Soy beans produce more digestible protein and fat than any other crop grown in Illinois as a feed for stock.

4. Corn produces more carbohydrates than any other Illinois crop, consequently corn and soy beans blend together to make a perfectly balanced ration for fattening purposes.

5. Illinois is one of the greatest corn and meat producing centers on the globe, which is one of the best arguments in favor of growing soy beans in Illinois.

6. Soy bean meal is equal in feeding value to gluten meal, cottonseed meal, etc., and thus by growing the soy beans himself the farmer and feeder can avoid the outlay of money for commercial feed stuffs.

7. Since cowpeas and soy beans are equal in feeding value to clover, but produce nearly twice the amount of digestible nutrients per acre as clover, it is evident that cowpeas and soy beans should become an important part of the crop rotation of the Illinois farmer.

XI. APPENDIX.

In order to learn certain facts with regard to the condition and development of the cowpea and soy bean in various parts of the world, the following letter and list of questions was sent to the American Consuls at about thirty foreign countries. Some very satisfactory answers were received, some of which are given herewith.

FAC-SIMILE OF THE LETTERS SENT TO FOREIGN CONSULS.

Urbana, Illinois, December 14, 1901.

Dear Sir:-

In preparing a thesis upon the Production and Distribution of Cow Peas and Soy Beans, we wish to get all possible information concerning these crops as grown in your country. Cow peas and soy beans are comparatively a new crop in the United States, being introduced into this Country only a few years ago, consequently our experience is limited. A great interest is being taken by the farmers of the United States in their culture and production, and it is very likely that these crops will be extensively grown in the near future.

The object of this investigation is largely to secure authoritative information of the extent and amount of cow peas and soy beans produced in the different countries of the world, and the chief uses to which these crops may be put; therefore any tables, figures, illustrations or results that you can give will be of great importance to this industry in the United States.

THE HISTORY OF THE UNITED STATES

OF THE

UNITED STATES OF AMERICA

1776-1876

The history of the United States is a story of a young nation that grew from a small colony to a great power. It is a story of the struggles and triumphs of a people who fought for freedom and justice. The story begins with the first settlers who came to the New World in search of a better life. They faced many hardships, but they persevered and built a new society. The story continues through the years of colonialism, the American Revolution, and the formation of the United States. It is a story of the growth of the nation, the expansion of its territory, and the development of its institutions. The story ends with the United States as a great power in the world, a nation that has shaped the course of human history.

I enclose a list of questions concerning these crops, which I would be very glad for you to answer, together with any further information of interest upon the subject that you can give us.

Thanking you in advance, I am

Very respectfully,

D. S. Dalbey.

LIST OF QUESTIONS.

1. Are cow peas and soy beans grown, and to what extent?
2. How long have they been grown?
3. Can you give any estimates of bushels produced in any particular sections or fields of known area? Estimated number of acres and yields of cow peas and soy beans?
4. By what names are the varieties called? What varieties are most generally grown? Why are these varieties preferred?
5. How are cow peas utilized by the farmers?
6. How are soy beans utilized by the farmers?
7. What are the methods of planting, cultivating, harvesting and threshing cow peas and soy beans?
8. How are cow peas fed to live stock? How are soy beans



fed to live stock?

9. Are cow peas and soy beans used in rotation of crops, as soil renovators, cover crops or catch crops?

10. How is soy bean seed stored? Do your farmers consider it a valuable crop? Why?

11. How do cow peas and soy beans compare with other legumes as fertilizers of the soil?

12. Are root tubercles formed upon the roots of cow peas and soy beans in your country?

REPLIES FROM FOREIGN CONSULS.

Consular Service, U. S. A.

Shanghai, March 1st 1902.

D. S. Dalbey, Esq.,

Univ. of Ill., Champaign, Ill.

Dear Sir:-

I hand you herewith answers to your questions in regard to soy beans.

You must recollect that in China there are no statistics; and also that farming is done by rule of thumb. I think, as a matter of fact, crops are rotated to get the very best results out of the ground; this, however, is not done consciously by the farmer. Each one does as his father did before him without any attempt to reason why.

Very truly,

John Goodwin,

Consul General.

COW PEAS AND SOY BEANS.

1. Are cow peas and soy beans grown and to what extent?

Ans. Yes. They are generally planted next to the staple wheat and kaohliang. They are the most important crops in North China. Owing to the entire absence of statistics it is impossible to know even approximately the extent.

2. How long have they been grown?

Ans. From time immemorial. The cultivation probably commenced during the Chow Dynasty 200 years B. C.

3. Can you give any estimate of bushels produced in any particular section or fields of known area? Estimated number of acres and yields of cow peas and soy beans?

Ans. In this district the yield per mow (one mow equals $1/6$ of an acre) average 150 catties (one catty equals $1-1/3$ lbs.) of cow peas. Of soy beans the yield is a little larger, viz: 1 mow produces 183 catties. The area under cultivation of the above cannot be estimated but must be quite extensive. 20 bu. per acre.

4. By what names are the varieties called? What varieties are generally grown? Why are these varieties preferred?

Ans. The Chinese names are too numerous to mention as each

district has its own nomenclature for the different varieties of these plants. The two varieties most favored by the farmers are the Whung-turh and the San-turh which means the yellow bean and the silk-worm bean. These varieties are preferred for their bearing qualities, their hardihood and relatively the slight amount of cultivation and care they require.

5. How are the cow peas utilized by the farmers?

Ans. When cooked or parched they are used as human food, also fed to stock as a fattener after being soaked in water. But the chief value of the cow pea is the oil cakes remaining after the oil has been pressed out and commercially known as bean oil and bean cakes. The oil is used for cooking and lighting purposes, while the cakes are used for feeding stock and as a valuable fertilizer. The farmer uses the stocks as fuel so that nothing is wasted of this valuable plant.

6. How are soy beans utilized by the farmers?

Ans. They are used as food boiled whole or grown into bean flour. The chief use of this bean is for the manufacture of soy.

7. What are the methods of planting, cultivating, harvesting and threshing cow peas and soy beans?

Ans. They are planted in parallel rows of 10 inches apart and four inches deep. After sprouting and when the plant is

about three inches high, the farmer hoes the patch, digging up all the weeds and loosening the earth between the rows. By the time the first blossoms appear a second and last hoeing takes place. In the case of cow peas the planting takes place in the 2nd. moon (March) and is harvested during the 8th moon (September). They are pulled up by the roots and tied into convenient bundles for carrying and whacking. The cow pea is obtained by whacking the tied bundles against a wooden railing inside of a large bin made of rush matting. The soy bean is also planted in the 2nd. moon in this district but in Southern and Central China it is planted during the previous autumn. It is harvested during the 6th. moon and is threshed out with sticks and flails.

8. How are cow peas fed to live stock? How are soy beans fed to live stock?

Ans. Cow peas are fed to live stock after being soaked in water together with chopped straw or hay. It is never given with fresh grass. Soy beans are seldom fed to live stock.

9. Are cow peas and soy beans used in rotation of crops, as soil renovators, cover crops or catch crops?

Ans. They are generally planted as alternating crops with wheat or other cereal. Sometimes as catch crop.

10. How is soy bean seed stored? Do farmers consider it a valuable crop? Why?

Ans. They are stored in may bins. The farmers consider the crop valuable because it is easy to raise and there is always a constant demand for the product.

11. How do cow peas and soy beans compare with other legumes as fertilizers of the soil?

Ans. As no other leguminous plants are cultivated as fertilizers of the soil it would be very difficult to draw any comparison.

12. Are root tubercles formed upon the roots of cow peas and soy beans in your country?

Ans. No.

James W. Ragsdale,

U. S. Consul,

Tientsin.

Consular Service, U. S. A.

Sydney, New South Wales,

April 9th, 1902.

Illinois College of Agriculture,

Champaign or Urbana, Illinois.

I take pleasure in enclosing you herewith an answer to the questions which you sent in regard to soy beans and cow peas made by the Secretary of Agriculture for New South Wales. The Agricultural Gazette published regularly in this country is supplied to the Agricultural Experiment Station, Urbana, Illinois, where you may refer to it at your pleasure.

I have the honor to be, Sir,

Your obedient servant,

Orlando H. Baker

U. S. Consul.

ENCLOSURE.

Report from the Principal of the Hawkesbury Agricultural College, Richmond, New South Wales, Australia.

QUESTION 1. Are cow peas and soy beans grown, and to what extent?

ANSWER. Yes. Cow peas are now grown on a large scale for forage and green manuring. Soy beans only on a very small scale.

QUESTION 2. How long have they been grown?

ANSWER. About ten years.

QUESTION 3. Can you give any estimates of bushels produced in any particular sections or fields of known areas? Estimated number of acres and yields of cow peas and soy beans?

ANSWER. Cow peas yield 15 to 25 bushels of seed and from 7 to 10 tons forage per acre. Soy beans yield from 2 to 5 tons green fodder and from 10 to 20 bushels of seed.

QUESTION 4. By what names are the varieties called? What varieties are most generally grown? Why are these varieties preferred?

ANSWER. Black Seeded; White Seeded; Whip-poor-will; Clay Colored; White's Perennial. Whip-poor-will, Black Seeded and Clay Colored preferred, as they are fairly early and yield the heaviest crops of fodder.

QUESTION 5. How are cow peas utilized by the farmers?

ANSWER. Either grazed off or ploughed in.

QUESTION 6. How are Soy Beans utilized by the farmers?

ANSWER. Either grazed off or ploughed in.

QUESTION 7. What are the methods of planting, cultivating, harvesting and threshing cow peas and soy beans?

ANSWER. See "Farmers and Fruitgrowers' Guide," and "Agricultural Gazette of New South Wales."

QUESTION 8. How are cow peas fed to live stock? How are soy beans fed to live stock?

ANSWER. See No. 5.

QUESTION 9. Are cow peas and soy beans used in rotation of crops, as soil renovators, cover crops or catch crops?

ANSWER. Yes. Cow peas are largely used in rotation as soil renovators and catch crops.

QUESTION 10. How is soy bean seed stored? Do the farmers consider it a valuable crop? Why?

ANSWER. Very little grown. Generally farmers have not been successful with soy bean, and from observations made it seems that this is mostly due to the absence of the proper bacteria.

QUESTION 11. How do cow peas and soy beans compare with other legumes as fertilizers of the soil?

ANSWER. Cow peas have proved to be the best summer crop yet



grown here for fertilizing purposes.

QUESTION 12. Are root tubercles formed upon the roots of cow peas and soy beans in your country?

ANSWER. Yes, very freely on cow peas, but not nearly as numerous on soy bean.

Consular Service, U. S. A.

Bordeaux, France, January 24th, 1902.

Mr. D. S. Dalbey,
College of Agriculture,
Urbana, Illinois.

Dear Sir:-

I am in receipt of yours of the 19th December, 1901, enclosing a list of inquiries you desire answered relative to "Cow Peas" and "Soy Beans."

I shall not attempt to answer your inquiries in detail. I have never seen the "Cow Pea" in France. I have some reputation as an observer and am not apt to fail to recognize old friends. It may be here, but if so, I think as a garden plant. I have certainly never seen a field of it in southern France.

I cultivated the "Cow Pea" extensively in North Carolina for 15 years. To my personal knowledge it has been grown in many of the states of the south for at least 40 years. I have taken much interest in it as a forage plant, especially for soil-ing purposes. For many years I used it with great satisfaction with a herd of milch cows in connection with boiled cotton-seed.

That was before cotton-seed was ground and had become an article of fodder either as "cake" or "meal."

As to treatises and reports on it there may be such things in the agricultural journals, etc., but as I do not know and am unable to learn the French name for what we call "Cow Peas", I cannot give you this information. If you know its French name, I would advise you to write to the Minister of Agriculture at Paris for any official reports that may have been made on the subject.

As to the Soy Bean, I am wholly at sea. One of the English authorities I have consulted says it is "the bean used for making Soy Sauce, the kidney (white) or French bean," and the Century Dictionary calls it the "Sauce or Soy bean." There are about a thousand different varieties of "French beans," and most of them might well be called "kidney beans." Indeed, another authority says the "kidney bean is the haricot." But there are any number of varieties of the "haricot," any one of which may be your "Soy," I have no means of finding out. I am thankful to know that no "Soy Sauce" is made here. That particular kind of salted nastiness is supplied to this market by English manufacturers. Because of this, I suppose no one here knows what the "Soy Bean" is.

I have had a good many inquiries from the United States about "Flagolette" beans, which are rather small, rich, greenish-colored beans, much prized for putting up. It is raised in this region in small patches, the seed being renewed each year from the north of France. Your inquiry as to the "Soy bean" may refer to this variety.

I am quite unable to give you farther information on the subject of your inquiries.

I am, Sir,

Very truly yours,

Albion W. Lourgee

Consul of the United States
at Bordeaux, France.

Consular Service, U. S. A.

Calcutta, March 19th, 1902.

D. S. Dalbey,

College of Agriculture,

Urbana, Illinois.

Sir:

Referring to your letter dated the 19th, December last, I enclose herewith a letter from the Reporter on Economic Products to the Government of India, containing all the information available as to the cultivation of Soy Beans in India.

Trusting the information will be of service to you.

Yours faithfully,

Actg. Vice & Dy Consul General,
U. S. A.

No. 55 Camp.

INDIAN MUSEUM,
1 Scudder Street,

Camp Palamput, the 12th March, 1902.

From

George Watt, Esq.,
Reporter on Economic Pro-
ducts to the Government
of India.

To

R. F. Patterson, Esqr.,

Consul General, United States,

Calcutta.

Sir,

In continuation of this Office letter No. 422, dated the 12th
February 1902, I have the honour to reply as follows:

Soy Bean, otherwise Cow gram or the Japan pea (*Glycine hispida*), is largely grown in India up to 6000 ft., and used as an article of food and also for fodder; but exact particulars as to extent of its cultivation and yield per acre are not available. No date can be assigned as to when the plant was first raised in India. The two chief varieties of the cultivated soy which are grown in India are called "white" and "black"; but they are not

distinguished by other characters than the colour of the seed. There may also be found plants which have become wild; then the cultivated plant differs chiefly from the wild in its greater hairiness, more erect stem and larger legumes.

The bean roasted and ground or simply roasted is eaten in India in those parts where it is cultivated. "The plant affords excellent fodder for all kinds of stock if harvested before it is fully matured." (Duthie and Fuller). On the plains of India the crop is generally grown by itself as a kharif (autumn) crop, the seeds are sown from June to September and are harvested from November to January. "The seeds should be placed at a depth not exceeding 1 to 1-1/2 inch; 18 plants to the square yard may be left after weeding. The plant prefers a peaty soil, or one rich in organic matter; a calcareous soil is also favourable to its growth. Sulphate of potash is a good manure, nitrogen may be supplied either as nitrate of soda or in the case of soils poor in organic matter, in the form of a rape or mustard cake, but it is rarely needed, while large applications of nitrogenous manure exert a distinctly injurious effect upon the yield of beans." (Church) Another authority recommends that the beans be dibbled into shallow beds of heavy loam rich in lime, the sowing season being April - July.

"Potash forms nearly one half and phosphorus pentoxide one third of the ash." (Duthie and Fuller). There can be little doubt that in common with other pulse crops, root tubercles are found on the roots of the soy bean in India and that hence the plant may be regarded as a valuable fertilizer of the soil.

Cow peas (Vigna Catjang). This pulse is a native of India, cultivated in the hotter localities generally for its grain. Recent particulars of area under the crop are not available. The earliest reference to the plant recorded in this office is to be found in the Proceeding Royal Asiatic Society 1838, page 62, Dr. Lush, Table Agriculture. Produce of country round Poona, Bombay Presidency, with the remark, sown, June; reaped August - September. Sir W. Elliot (Flora Andhrica, 1859, pages 13, 28, 83 & 94), makes several allusions to this plant.

In Bengal the crop is said to succeed in loamy and sandy soils but not in clay soil. It comes after paddy (rice) and is followed by the same crop. Seed sown in the end of September at the rate of 5 seers (10 lbs.) per bigha (one-third acre) either alone or mixed with mustard. The average yield is from 1/2 to 2-1/2 maunds (40-200 lbs.) per bigha. Several races exist which differ in the colour of the flowers and seeds; and one of these,

with very long pods, is cultivated by market gardeners as a vegetable. The pods are picked while green and take but very unworthily the place occupied by French beans in European cookery. The seeds vary considerably in colour, the white kind being considered the best. (Duthie and Fuller). It is less frequently grown in the North-West Provinces than green gram (Phaseolus Mungo) but it forms the undergrowth in a large proportion of kharif (autumn) millet and cotton fields with which it is sown at the commencement of the rains. It ripens in October - November. Reports from Bombay state the crop grows best in black soil, is sown in June and reaped in November. In North-West Provinces, Punjab and Bombay it is usually sown as a mixed crop. Professor Church says Vigna Catjang is sown in July - August and reaped October - November. It flourishes in comparatively poor soils and sustains fairly well a considerable degree of drought.

The grain is eaten either as flour or split. It is considered less wholesome than green gram (Phaseolus Mungo). The stalks and leaves are used as fodder.

As regards fertilizing power and root tubercles found on the roots, see remarks under soy bean.

The foregoing reply has been framed as far as possible on the lines indicated by your letter and I trust the particulars

given may be of some small service to your correspondent. It has not been possible to answer all the enquiries, for the conditions of agriculture of India are such as to make it difficult to collect precise information on this and kindred topics.

I have the honour to be,

Sir,

Your most obedient Servant,

J. Henry Winkill

For Reporter.

Consulate of the United States of America,

Birmingham, England, January 14th, 1901.

Mr. D. S. Dalbey,

College of Agriculture,

Urbana, Illinois.

Dear Sir:-

In the absence of Mr. Halstead, who is at present in the United States, your letter of December 20th was opened by me. I asked a gentleman who is engaged in the seed and corn business to fill in the answers to the list of questions you sent and enclose you a complete copy of the questions and answers, which, I think, will give you all the information which you may require.

Yours very truly,

Vice and Acting Consul.

1. Are cow peas and soy beans grown, and to what extent?

Yes, as a rotation crop to enrich the ground, generally speaking all over the bottom half of England.

2. How long have they been grown?

Hundreds of years, beans especially.

3. Can you give any estimates of bushels produced in any particular sections or fields of known area? Estimated number of acres and yields of cow peas and soy beans?

Forty bushels per acre, peas. Forty-five bushels per acre, beans.

4. By what names are the varieties called? What varieties are most generally grown? Why are these varieties preferred?

Common grey or Hackett, Dunn, Goldfinder - grey peas. Common Horse bean, white eyed, black eyed, Tick, Water bean. These are the hardiest and most prolific.

5. How are cow peas utilized by the farmers?

Mostly for sheep, and also ground and used with other meal as oats, beans, etc., for feeding stall fed cattle.

6. How are soy beans utilized by the farmers?

Sold for Horse corn.

7. What are the methods of planting, cultivating, harvesting and threshing cow peas and soy beans?

Usually sown instead of clover. Peas sown in spring, cut with hooks and ricked. Beans cut with machine and ricked.

8. How are cow peas fed to live stock? How are soy beans fed to live stock?

To sheep when dry and six months in rick. Mixed with other food; too heating by themselves.

9. Are cow peas and soy beans used in rotation of crops, as soil renovators, cover crops, or catch crops?

A good predecessor to wheat in each case.

10. How is soy bean seed stored? Do your farmers consider it a valuable crop? Why?

In rick till threshed. Yes, like all other legumes.

11. How do cow peas and soy beans compare with other legumes as fertilizers of the soil?

No better fertilizers can be had, but they are never ploughed under green.

12. Are root tubercles formed upon the roots of cow peas and soy beans in your country?

Yes.

(Signed) Sale & Son, Atherstone.

N.B. The above questions are answered on the assumption that the peas alluded to are grey field peas, and beans ordinary horse beans.

Consular Service U. S. A.

Cape Town, South Africa.

Feb. 17th 1902.

Mr. D. S. Dalbey,

Urbana, Illinois.

Dear Sir:-

Answering your letter to Col. Stowe, my predecessor, of Dec. 19th 1901, will say that I have made every effort to try and get some information in reference to the raising of soy beans and cow peas, at your request.

I am very sorry to be compelled to state that I have made no progress. The farming in this country, especially in this part of it, is still very limited, and they know little or nothing about cow peas or soy beans.

I enclose in this a letter from the Department of Agriculture in this colony.

I have the honour to be,

Sir,

Your obedient servant,

W. R. Bigham
U. S. Consul-General.

Department of Agriculture.

Cape Town, 15 February 1902.

Sir:-

With reference to the enquiry contained in your letter of the 11th inst respecting the cultivation of the cow-pea and soy-bean.

I beg to advise you that as far as I am aware there is no place in this Colony where the cow-pea and soy bean are cultivated. They have merely been tried in experimental garden plots by private individuals so far as I know. The Muscana or velvet bean has been grown by Major Elliot to a small extent, but this is not the class of fodder you seek information on.

I regret, therefore, that I am unable to offer the particulars you require. We have yet much to do in this Colony towards providing artificial feeding for our stock, and the culture of these varieties has yet to be taken up.

I am

Yours faithfully,

E. Pillans.

Consular Service, U. S. A.

Rio de Janeiro, March 13, 1902.

D. S. Dalbey, Esq.,

University of Illinois,

Urbana, Illinois.

Dear Sir:-

Referring to my letter of January 27th, I made various inquiries regarding the production of cow peas and soy beans in Brazil. Mr. Orville A. Derby, the President of the Geological and Geographical Commission of the State of S. Paulo, an American expert of international reputation, writes me the following:-

"Neither of these are raised as crops in any part of Brazil within the last few years and a few sporadic attempts have been made to introduce them, but thus far without attracting any general attention."

Very respectfully yours,

Eugene Seeger,

Consul General.

Consulate-General of the United States of America.

St. Petersburg, May 9th 1902.

Mr. D. S. Dalbey,

College of Agriculture,

Urbana, Illinois.

Sir:-

Your letter of December 20th 1901 was duly received and I immediately applied for the information you desired regarding the cultivation of soy beans and cowpeas. I have this moment received the reply of the Minister of Agriculture, which is as follows:

"Soy beans have been cultivated in limited quantities since 1874, by small farmers in the provinces of Kharkov, Poltava, Kiev, Podolia, Kherson, Bessarabia, Grodno, Minsk, Vitebsk, and Vistula. The only place they are cultivated in any considerable quantity is on the estate of Hetmanovka, of the Balt district, province of Podolia. Small quantities have been cultivated in the Trans-Caucasus and Turkestan; it is not regarded as a feature in Russian farming. The only two varieties are the early black, formed like haricot, and the early brown, with larger grains and lentil form.

D.S.D.-2

"Cowpeas are cultivated to a considerable extent in the Caucasus and Turkestan, where they are used as a substitute for the kidney beans and are of a considerable importance in farming."

Very respectfully,

W. R. Holloway

Consul-General.



The following list of questions was sent to some of the most successful growers of cowpeas and soy beans in this and other states. Over fifty replies were received, the best of which are given herewith.

COWPEAS AND SOY BEANS.

1. How do you prepare your seed bed for planting cowpeas and soy beans?
2. What is the best method of planting cowpeas and soy beans - broadcast or drilled - and in each case how much seed per acre do you sow? How would a four-row sugar beet planter do? In drilling how far apart would you plant the rows?
3. Cultivation. What do you cultivate your beans or peas with? Is the weeder or beet cultivator good to use?
4. How do you harvest for hay? Time and method of cutting, curing and stacking?
5. How do you harvest for seed? Method of cutting, drying and threshing?
6. Feeding. Can you give any results from feeding cow peas or soy beans, either as hay, threshed seed, straw, etc., that you personally know of?
7. Can you give me any figures showing an increased yield of corn, wheat or oats, due to a previous crop of cow peas or soy beans?
8. Varieties. What in your opinion are the best varieties to grow in Illinois? What are the average yields of these

varieties in your locality? What varieties are best for hay or forage? What varieties are best for seed?

9. How do you store your cow pea or soy bean seed during the winter? Can soy bean seed be stored in sacks or granaries without endangering the vitality of the seed? Is fire drying necessary?

10. From your experience, how do cow peas and soy beans compare with clover in Illinois, (1) as soil restorers, (2) as feed for stock and as an economical and profitable crop for the Illinois farmer?

Woodside, Del., March 7th, 1902.

Mr. Dwight S. Dalbey,

Champaign, Illinois.

Dear Sir:-

Your favor at hand with list of questions regarding Cowpeas and Soy beans. My experience with the Soy beans has been very limited. Their harsh, bushy nature of growth I have always considered as making them inferior to the Cowpeas. The Cowpea I have grown as a soil restorer and feed. I consider them the ideal soil restorer for light lands deficient in nitrogen and for clayey lands deficient in both nitrogen and humus, as it makes them very friable. My principal custom has always been in feeding, to use them through the silo with the corn.

No. 1. For soiling purposes, that is to turn under, I sow them with a wheat drill, setting the drill to sow 2 bushels of wheat and taking up every other sprout. This will give a bushel of peas to the acre. We sow them here about the middle of May or the first of June, the important being to wait until the ground is thoroughly warmed, as they are very tender and will decay with moisture without heat sufficient to germinate them. They can be either turned under for wheat, as has been my custom, or they can be mown for hay. For silo purposes we usually plant them

with a corn planter in this wise: Plant the corn 4 feet apart with the plates that drop a grain every 8 inches, and after getting through with the corn immediately put in the peas and drive down exactly the same row. This enables the peas to run up the corn and can be harvested with a McCormick corn harvester and cut into the silo. Experience has taught me this is an idea feed.

No. 3. The cultivation is best done with a weeder in the early stage for either the soiling, hay or silo purposes as last described than an ordinary cultivation.

No. 4. The best way to harvest for hay is to cut them with a mower about the time they are in bloom without any dew, and put them in the shock to cure. Length of time, of course, depending upon weather, but the idea is not to let them get too ripe or let them lay exposed to the sun to the extent of allowing the leaves to shatter as they, like clover, contain the most and best feed element. This is somewhat the reverse of cutting for the silo as you then want the peas to be there instead of the vine and it should be planted with a variety of corn which will mature about the same time they will. I have cut this crop when the corn was 40 bushels to the acre and the peas 10 (New Era peas and Early Mastadon corn).

No. 5. I have never harvested any for seed except in just a limited way as a matter of experiment and that was by hand. Seemingly the best method is to cut them when they are damp from dew in the morning, after being fully ripe, get them in bunches and thrash them with a fodder cutter run at slow speed the knives being reversed; that is, the back of the knives put on so that they will pass the ledger plate and knock the peas out.

No. 6. Answered previous.

No. 7. My experience in the increase of crops from the result of growing Cowpeas is by sowing Crimson clover at the last harrowing of corn, the following May turning it under and sowing Cowpeas, which turned and sown to wheat in August has increased the wheat yield with me from the average of 12 bushels to the acre to 22. I have grown favorable seasons 35 bushels to the acre by this method.

No. 8. Of course, my opinion as to varieties in Illinois can only be conjecture, but I have no doubt but the New Era, which we consider the best here, or Whippoorwill, or Black would be suitable to Illinois. Of course, being a southern plant, to grow them in the North the earliest varieties should be used, but they are very adaptable, that is to say, they adapt themselves very readily to conditions and soon become acclimated. The

Granit will not mature seed with us, yet, I have seen it by taking the few seed it did mature the first year and they being planted mature a crop of seed the second year. Regarding average yields, as I said before, I have not grown any expressly for seed and do not know from experience just what the average yield should be, but would judge 20 to 30 bushels of the varieties in the order named above.

No. 9. They can be easily stored during the winter in bins, barrels, or bags the same as any other cereals are stored. It may be necessary to use bi-sulphide of Carbon upon them for weevil.

No. 10. Having had no experience with either Cowpeas, soy beans or Clover in Illinois, cannot speak positively. I think, however, judging from the soil of Illinois that I have seen and its climatic conditions that the Cowpea is superior to the clover as a soil restorer, for the reason that it is more of a nitrogen gatherer. The nitrogen nodules are much greater than on clover and they will grow upon land that clover will not. As a feed for stock, whether grown in Illinois or any other locality, they certainly are superior to clover, because they yield a greater tonnage per acre, while the feed content is greater; therefore, I can see no reason why they should not be a profitable crop for

the Illinois farmer.

No. 11. As to the matter of clover sick, I have very decided views that it is simply soil exhaustion that will be readily remedied by the application of the one absent necessary food with us, phosphoric acid. The Cowpea might possibly, by continuous cropping without any rotation, become what this term implies - sick - but it is not likely to, for the reason that it is more of a hustler as a plant than the clover.

No. 12. I hoped to learn before answering you, and have deferred answering for this purpose, of some parties who had them for sale. Mr. C. C. Brown had some but I cannot learn whether he has sold them or not. They were the New Era variety and strictly first class, having been passed upon by our Experimental Station. He sold them for \$2.00 per bushel.

If there are any points which I have not covered, I shall be glad to do so, as I place a great deal of reliance in the Cowpea both as a soil restorer and a food producer and am glad to do anything to further its use. You, therefore, need not hesitate to ask me any questions and I will be glad, if I have the knowledge, to comply.

Yours truly,

(Dictated G.)

Wm. M. Dickson.

DuBois, Illinois, Feb. 26, 1902.

Mr. Dwight S. Dalbey,
Champaign, Illinois.

Dear Sir:-

I have your letter of the 20th inst. at hand. Have just returned to-day from attending the State Institute at Rockford, Illinois. Will answer your questions to the best of my knowledge and experience.

1st. I prepare the seed bed for peas and soy beans about the same as for corn, but do not plow the ground quite as deep. I prefer to drill both crops in rows about 34 inches apart, using a bushel to 3 to 5 acres and cultivate 2 or 3 times keeping the ground as level as possible, using a two-horse cultivator with 8 shovels and the one-horse 13 tooth cultivator. I have had no experience with the sugar beet planter.

For seed or hay I cut with a mower and after wilting rake and put in small shocks. The cow peas for hay or seed I let ripen a good lot of pods unless there is danger of frost. The soy beans are best for hay when in full bloom or soon after; for seed they will do to cut when the leaves and pods begin to turn yellow. For hay or seed cut and let wilt, then rake and put in

small shocks until well cured, when they can be stacked or put into the barn.

I can give no definite results as a feed, because I have fed in connection with other feeds. I have fed as hay, also some of the threshed seed and a large amount of the straw. The latter I am now feeding to 100 head of sheep. They have had but little other feed this winter.

I cannot give you any figures as to the increase in yield of other grains planted on land after growing a crop of these legumes.

As to the best variety for Illinois that will depend on what is wanted and the time of planting. For a crop to plant at the same time and with corn the Early Black Eye would probably be the most satisfactory; to plant about June 1st for a big yield of vine and seed the Clay and Red Ripper would give good results here in southern Illinois. For seed, the New Era would probably be the best, with Whippoorwill and Black close to it. I have no definite figures at hand, but think a good average crop of Whippoorwill is about 10 bushels to the acre. This may be a little high.

Of the soy beans, the Medium and Mammoth are both good for hay, the latter making the most growth but the stalk is some

larger than the Medium, which I think makes them about equal in value for a hay crop. For seed, the Medium will out-yield the others unless it be the Early Green Medium. This Early Green is not quite as large as the Medium and ripens with the Dwarf. I have lost considerable seed by storing in bulk, so that I think that method quite unsafe. Fire-drying might be all right. Have had no experience with it. My experience is that they are both better than clover for feeding and for soil renovation because I cannot grow clover here. I bought five tons of clover this winter. I do not like it as well as the soy bean straw.

I cannot refer you to any farmer who has seed for sale. All I know of who had any extra seed sold to dealers about here at \$2.00 per bushel.

I have some seed on hand and after filling present orders may be able to spare a little. I have some of the Early Black Eye, but Professor Blair tested some of it with poor results. I tried one lot which germinated about 95% and intend to try another. We have not grown these crops for a series of years; that is, long enough to determine if the land will fail to support them as is often the case with clover.

I believe I have now made an attempt to answer all your questions.

The average yield of the medium soy bean would be about 20 bushels, I think.

Yours truly,

A. A. Hinkley.

I will send you some seed, for pot tests, of several varieties.

A.A.H.

Lafayette, Ind., October 23, 1901.

Mr. D. S. Dalbey,

Champaign, Illinois.

Dear Sir:-

Your communication of the 15th duly received, and in reply would say that the data has not as yet been fully completed. In a general way, however, I can give you some idea of the work done by myself this summer. In the first place, the work was of a preliminary nature. I desired first of all to determine whether our soils were well inoculated with the symbiotic micro-

organisms of the plant. If not, to determine what benefit might accrue from inoculating the soil with earth from a plat in which they were grown the previous season. Two types of soil were used, a black loam from the Station farm and a clay loam from a partially worn-out field some two or three miles from the city. Fifty-six pots were used - twenty-eight in cowpeas and the balance in soy beans. Twelve pots in each lot were of black loam. Besides this, six trucks were used having a surface area of $2\frac{1}{2} \times 7$ ft. each, one-half in cowpeas and the other half in soy beans.

No noticeable difference could be detected in the soy beans throughout their growth, but in the cowpeas, especially in the black loam, there was a marked difference in those pots which were inoculated after they had attained the height of 12 to 14 inches; previous to that no difference could be noted.

As the yield of grain was the principal test of increase from inoculation, I shall simply give you some percentages of increase:

Cowpea in Black Loam in Pots.

Group I soil not inoculated.

" II soil inoculated with soil. 70% increase over I.

" III seed inoculated with soil infusion. 13.6% increase over I.

Cowpeas in clay soil gave negative results as the clay soil seemed to be well inoculated with the organisms.

Cowpeas in Black Loam in Trucks.

Group I not inoculated.

" II inoculated with soil. 29.7% increase over I.

" III seed inoculated with soil infusion and soil supplied with nitrate of soda. 14.9% increase over I.

Soy Beans in Trucks, Black Loam.

Truck I soil not inoculated.

" II inoculated with soil. 10.6% increase over I.

" III seeds inoculated with soil infusion and soil supplied with nitrate of soda. 53.9% increase over I.

The data on the soy bean experiments in the pots is not completed, but I have every reason to believe that they will be more or less negative in character. Our soil does not seem to contain the soy bean root tubercle germ.

I shall be pleased to receive any data which you may choose

to send me.

Nothing has been published by the Station as yet that directly bears upon this question.

Yours truly,

Wm. Stuart.

Roann, Ind., Feb. 24, 1902.

Dwight S. Dalbey,

Champaign, Illinois.

Dear Sir:-

Your inquiry of 2/21 at hand. In reply will say I have had no experience with cowpeas but will try and reply to your questions in regard to soys.

(1). In preparing seed bed for soy beans I plowed land from 6 to 8 inches in depth about the first of May, following with drag to hold moisture. Harrowed thoroughly with spring-tooth harrow once a week until planting time, the first of June.

(2) Planted beans with disc grain drill, stopping up all but two holes, making rows 35 inches apart. For hay, I have

had no experience. Would drill because the beans are not easily covered with harrow when sown broadcast; consequently a great many would not take root. In drilling, I use about 25# to the acre.

(3). Cultivate with a five-tooth one-horse cultivator. Weeder would be a good tool to use if used at proper time before weeds were well started.

(4). I cut beans before leaves fell off and threshed in about 2 weeks after cutting and cattle, sheep and horses are very fond of the stalks after the beans were threshed out.

(5). Cut when leaves begun to turn yellow and pods were all matured. Cut with a Champion self rake machine. Let them dry as they fell off the table, in bunches. Threshed with common grain separator with all the concaves taken out and boards or blanks substituted. Very few beans were found in the straw.

(6). Have made no tests as to their feeding value but know that hogs, horses, cattle, sheep and poultry are fond of the beans either whole or ground in connection with other grains. A very small amount of soy bean meal added to the ration for milk cows gave a decided increase in the milk flow. Cows fed rye straw and bean straw with a small feed of corn and oats ground together gave as much milk as others fed shredded corn fodder

and the same grain ration.

(7). Have followed soys with rye sown late last fall and cannot give results now. Will sow red clover in rye this spring.

(8). Early White are best for seed in this latitude. Medium Early Green I prefer for hay. On very poor, sandy soil I had an average of 1 bushels to the acre last year.

(9). Store my seed in bins in barn away from all dampness. I know from experience this is a safe plan to store seed. Fire drying is not necessary if beans are well dried before threshing. If they are green, would heat and mold.

(10). Have not had experience enough to answer, but think they should be used more as a catch crop in case of failure of clover or to grow both crops (clover and beans) when possible to give more variety in compounding rations. As a feed for stock they are just what the stock feeder needs to take the place of bran and linseed meal. I shall plant 25 acres this year for seed and expect to feed them all to my stock in connection with crushed corn and cob, barley, rye and oats.

They are very slow to grind, some millers refusing to grind them. I grind and mix my own rations and grind some beans for neighbors.

I have about 50 bushels of seed beans left for sale at \$3.00 per bushel, 1/2 bushel \$1.60, 1/4 bushel \$.90. All recleaned and as good as sample mailed you to-day.

I am,

Yours truly,

J. E. Ross.

Richmond, Va., Nov. 4, 1901.

Mr. D. S. Dalbey,

Champaign, Illinois.

Dear Sir:-

Your favor of the 31st received, and contents noted. We have no difficulty in keeping Cow Peas and Soja Beans, provided they are properly cured and dried before threshing. Our farmers do not usually thresh them out of the hulls until during the winter - December or January. By that time they are usually well dried and cured, and there is no difficulty about keeping them in bulk. It is very much better to leave them in the hulls and not to thresh them until they are ready for market or to sow.

Yours very truly, T. W. Wood & Sons.

Jacksonville, Ill., Feb. 26, 1902.

Friend Dalbey:-

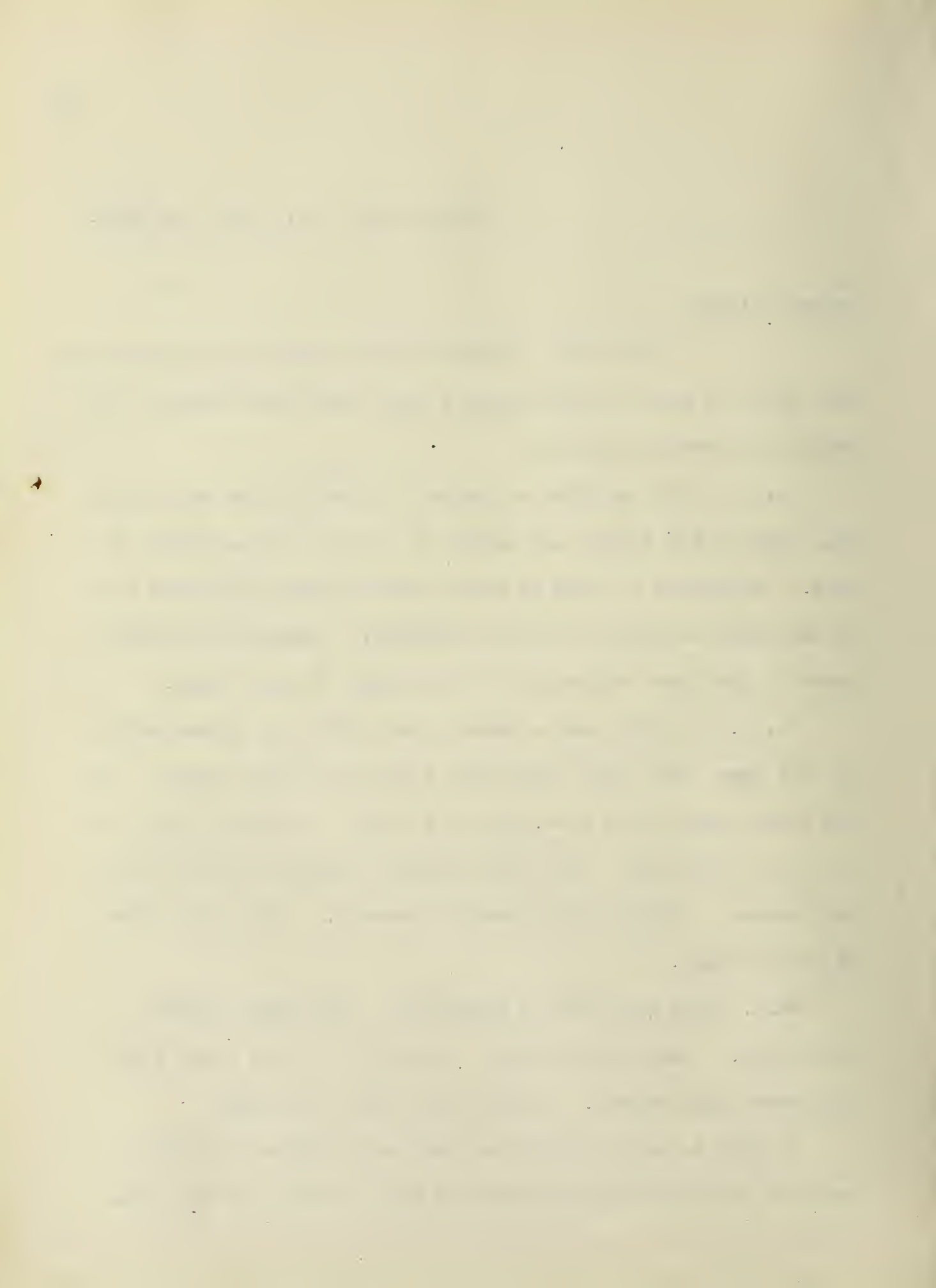
I fear that I cannot answer your list of questions very fully as most of them are the very points upon which I am seeking information myself.

No. 1. Will say that we prefer to plow or disc our pea or bean land in the spring and harrow it in seed bed condition at once. We desire to have as many crops of weeds germinate and be destroyed as possible before planting. However, soil prepared in good corn shape will be all right for soy beans.

No. 2. We have used a wheat (hoe) drill 1st season using all the hoes, last year using only 3 hoes 24 inches apart. In the former case, used 1 bu. per acre seed; in later, from 1/2 to 5/6 bu. per acre. Have just bought a sugar beet drill and cultivator. Going to try them this season. Will drill them 20 inches apart.

No.3. Last year used a Planet Jr. One horse garden cultivator. Cultivated twice. Going to try the 4-row beet cultivator this season. Never have tried the weeder.

In 1900 we cut a little for hay about middle of August. Tried to cure about like clover and put the hay into the barn.



It was not cured sufficiently and moulded badly.

No. 5. Saved about 1/2 acre for seed this year. Cut about September 20th when the pods were yellow and top ones were turning brown. Cut with mowing machine. Found no difficulty in mowing when driving with the rows. Let them get thoroughly dry (in this case 4 or 5 days). Put them in a rail pen and covered with boards. Threshed them out this week beating them out with a flail and fanned them with a mill. This was, of course, the best I could do with such a few.

No. 6. Nothing beyond what I have already given you.

No. 7. No figures, but could easily see last year in corn field the difference in the thrift of corn where both cowpeas and soy beans had been the year before.

No. 8. We have only used the Yellow Dwarf. There were a few of the later (green) variety mixed with mine last year. I pulled them out and will plant separately this season. Our yield this year was about 22 bu. per acre.

No. 9. The seed which I have threshed out this week I put in 2 bu. burlap sacks putting only one bu. in each sack. There I lay loose and flat on the floor so that the beans are not more than 4 to 6 in. thick. If I had quite a few I would lay them up in tiers with boards in between like the breeders store their

seed corn. Something like this

No. 10. Have not had enough experience to answer these. Soy beans in our experience compare favorably with clover, but do not compete with or take the place of clover, as clover comes in the spring and early summer while soy beans answer the same purpose in the fall and winter.

Do not know whether the land will become bean sick or not. Think, however, that land will become sick of any crop if asked to raise it continually. We got our seed last year of Scott Wilkins, Fishhook, Illinois. Also you might write to H. B. Rice, Lewiston, Illinois.

I hope, Mr. Dalbey, that the information you get from the various replies of your question list will be published in a bulletin. At any rate I should like to know some of the results of your investigation.

Yours in the interest of the soy bean,

C. A. Rowe.

Carmel, Ind., Feb. 26, 1902.

Mr. Dwight S. Dalbey,
Champaign, Illinois.

Dear Sir:-

In answer to your letter of inquiry will say that we do not claim to be cowpea and soy bean specialists in full meaning of the word, but we are interested in and experimenting with them and think they are proving to be a great food for farm animals. Necessity points towards farmers growing their nitrogenous foods instead of paying enormous prices for bran, oil meal, etc. We have not grown these crops but two years, but they have done well with us both seasons. We send you samples under separate cover. All samples were grown by us last season. Will answer questions to best of ability.

(1). Plow in spring same as for corn; work ground with disc harrow, roller, acme harrow, and drag until you get a fine seed bed; aim to do most of cultivation before planting.

(2). We always drill with 11 disc Superior. About 20# per acre. Never saw a beet planter. We plant the rows 28" to 35" apart for seed; for hay, 7" to 14".

(3). Use weeder second day after planting; after plants are up use weeder and spring tooth cultivator (5 teeth in gang). Do not use weeder while plants are damp with dew.

(4). Have not had enough experience to give advice. Raised plants for the seed and manuring.

(5). Last season cut with mower with American buncher attached, but will use this season a self-rake, superior to above. Use false guards on cutter bar (about four guards); this is to lift branches up that lay on the ground. Let the vines dry in bunches two or three days; then thresh with grain separator, all concave teeth taken out except four. Run cylinder slower but the rest of the machine should be speeder higher.

(6). Cannot give exact results in feeding as we feed them in a mixture of other grain. We are feeding the following to 14 pigs 4 months old, weight 112# each: 3 bu. shelled corn, 2 bu. wheat, 1 bu. oats, 1 bu. soys and 1 to 2 bu. in bulk of cut clover hay; this is ground fine and soaked from one meal to the next. About 3-1/2 gal. is fed at meal, with three or four ears of corn additional. Pigs are doing extra well; fat and sleek.

(7). We sowed field in rye, then in soys and peas again. Cannot give figures. Have not grown grains after these crops until this year we seeded a 3-1/2 a. plot with hand-picked Red

Russian wheat; left most of vines on ground.

(8). Soys: Early Yellow, Medium Early Green, Medium Early Black and Early Brown.

Cowpeas: Red Ripper, Warrens' Extra Early and New Era. Yield from 8 to 20 bu. per acre. For forage for hogs, Black Soys are best. For seed, Warrens' Extra Early, Red Ripper peas; Brown and Early Yellow for the soys for seed. For hay, Red Ripper peas and Medium Early Green soys.

(9) Leave them in sacks for some time; then store in bins in granary like wheat. Have not experimented with the fire drying or tested for results in figures of the vitality.

(10). Our experience being limited, owing to short time that we have been growing these crops, cannot answer this fully. We think that they are clovers equal at least. As for "clover sick" land will say that we think that it is caused by cutting the clover off, the pasturing the field close, then put in corn, then wheat, then clover, then the same plan followed year after year, everything taken off, nothing put back, clover is starved and no wonder it is "sick land"

If we have not answered as fully as you like please write us again. Would be glad to hear from you.

Yours respectfully,
Kinzer Bros.

Raleigh, N.C., October 29, 1901.

D. S. Dalbey, Esq.,

Champaign, Ill.

Dear Sir:-

Yours of the 27th at hand. I send to-day some bulletins that may be of help to you. I have for many years been fighting the battle for the cowpea in the agricultural press mainly. As a long time contributor and now chief editor of the Practical Farmer of Philadelphia I have probably done more to rouse interest in the Southern pea than any other man in the country. The so-called cowpea of the South is really more of a tender bean than a true pea, and the name often causes farmers northward to mistake its character, and to imagine that they can be sown with oats in the early spring. The Cowpea is a hot weather plant, and will endure drought better than almost any crop grown for forage purposes. The varieties grown in the South are innumerable, but there are two general classes, the bush and the running sorts. Some of the latter run prone on the ground and are hard to save, while others like the Wonderful or Unknown grow erect at first and then develop runners and grow very rankly. Most of the running sorts are too late for the

Northern climate. The earliest varieties are Warren's Extra Early, New Era, and the Early Black Eye. Any of these will ripen a crop in sixty days. I have grown this season two crops of the Early Black Eye, one planted in May and seed from this planted in August was ripe in October. Whippoorwill is about the most popular pea in the west. It has small, speckled seed, and matures in about 85 to 90 days. Red Ripper and Wonderful are rank-growing sorts but entirely too late for localities north of N. C. The Clay is a running sort that ripens fairly early. It ripened from seed sent from here at Cornell. The Black is the name of a group rather than a variety. The large seeded Black is a strong grower and moderately early. It too ripened at Ithaca. There are a number of Blacks which are late in ripening and are smaller in the seed than the early Black. The Revenue is a very prolific bush sort that might do northward. Stewart or Galico is a strong grower and of medium season. The seeds are mottled red and white. The most popular variety in the South is the Wonderful, also known as the Unknown and Quadroon. It has pale, drab colored seed. It is, as I have said, too late for the North. Here it makes the heaviest crop of any. The Early Black Eye has been ripened in Wisconsin as also has Warren, and I have had samples from there. The cowpea has in-

vaded the North to stay, and I have word from a dairyman in Southern Vermont who says that he cannot get along without it. I sent six carloads of seed North last spring through dealers here. The soy bean is grown here to some extent, but cannot compete with the cowpea. You should grow the early varieties of these too. Dr. ... R. Capehart of Avoca, N. C. has experimented more with the soy than any one else in this state, and has grown a great many varieties. He can tell you more about the varieties than I can. The Medium Early is the one grown here. I have never heard of any difficulty in keeping the seed except that it must here, like all such seeds, be guarded from the weevil carefully.

Yours truly,

W. F. Massey.

Soy Beans.

1. Plow, Drag, Harrow and Roll until the soil is in fine condition.

2. Plant in drill just far apart so as to cultivate. Do not find that they do well sown broadcast with us. Some kind of a drill is best, but not a press drill. Plant one-half bu. per acre for seed, more for hay. They seem to need some cultivation in either case. I plant with a corn planter in drills 3 inches in row. It is best not to run the wheel over the row but leave the soil light above the beans. Cover about one inch deep, less than that will do very well.

3. Cultivate with any cultivator, one or two horse. A weeder does well in loose soil after the plants become tough, but at first the stems seem brittle and break easily.

5. Cut with a common mowing machine, and let lie on the ground till dry. Then throw in bunches or stack till ready to thresh. Small bunches do not injure much from rain, except those pods that are next to the ground. When stacked they should be covered so as to shed water.

6. Stock is very fond of the leaf either dry or green, and seem to enjoy picking over the dry sticks of the straw after threshing.

8. The "Dwarf" to mature early for hog pasture. The "Medium Early" for hay or seed crop. Find the yield about 20 bu.

9. If perfectly dry the seed will not injure if stored in sacks; otherwise spread thinly on a floor. Have not practiced fire drying.

10. I should certainly consider soy beans an economical and profitable crop as feed for stock in Illinois, especially for hogs, either as pasture in summer and fall, or as grain in winter.

Chas. A. Hilliard,

Brighton, Illinois.

Humbolt, Illinois, February 26, 1902

Mr. Dwight S. Dalbey,

Champaign, Illinois.

Dear Sir:-

Replying to your letter of the 20th inst. would say that we have, as well as we could in the brief space of time we had for it, given you a brief description of the cultivation

of soja beans. I have been over-burdened with business the last few days and on this account am not able to give you description in detail as I would like to.

The soja beans I grow are the Medium Yellow and are extra choice quality. I can furnish same for \$2.50 per bu. F.O.B. cars at Humbolt. If you desire I will send you a sample by return mail.

Thanking you for your interest in the matter and hoping this brief explanation will be of benefit to you, I am

Yours very truly,

J. O. Toland.

I. Seed bed for cow peas or soja beans is prepared much the same as for wheat or broomcorn.

II. The methods for planting soja beans or cowpeas depend much on the use you intend to make of them. If intended for hay crop, the best plan is to sow broadcast; for seed, it is better to sow in drills three feet apart. Use wheat drill and take out spout. When sown broadcast for forage and soil-improving crops, the soja beans should be sown at the rate of one bu. per acre. Sowing them thickly will prevent the stalk from

growing too coarse and enable them to be cut and turned under to better advantage. Sowing for ensilage, it is better to sow in drills with corn at the rate of about one peck to the acre. Or they can be sown by themselves in drills three feet apart, at the rate of 1 to 1-1/2 pecks per acre, and cultivated. They will make the largest yield of beans if put in this way.

In my experience, I find that the light surface cultivators give best satisfaction.

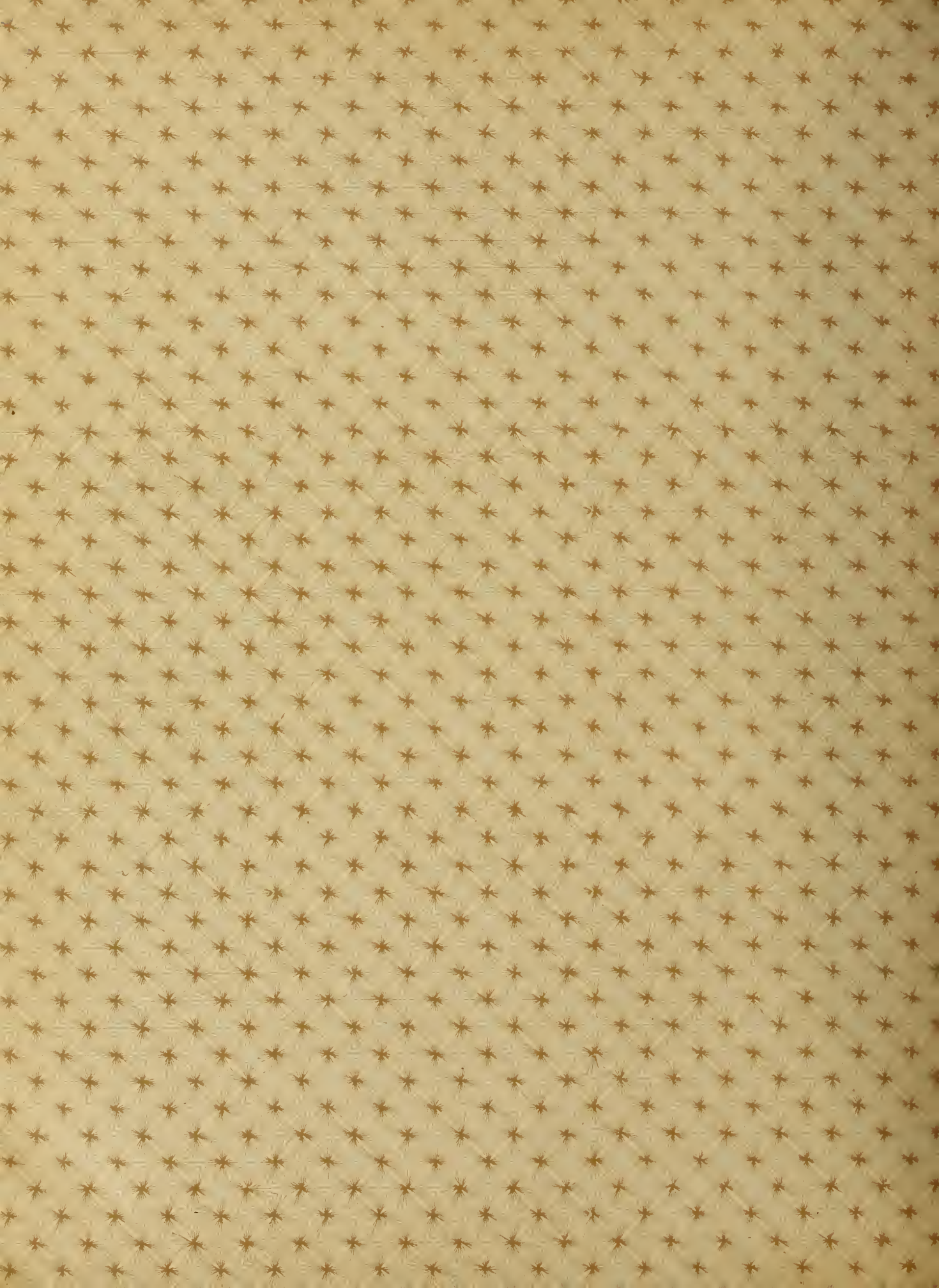
Cow peas and soja beans are unquestionably the richest and most nutritious forage and feed crop grown, making the "Balanced Feed" for hogs, poultry, and fattening stock. Also makes a splendid soil improver, and is unequalled as a drought-resisting crop.

The best variety of soja bean for this soil and climate is the Medium Yellow variety.

The best method of handling for seed is to cut when the pods get brown, when dew is on the beans, rake next morning when dew is on and haul in the evening and store in a well-ventilated seed house, or thrash and scatter on dry floor about 2 inches thick, and stir twice a day for about five or six days, bag in two bu. bags in well ventilated seed house, and result will be satisfactory, also results of beans stored in shed, and thrashed

in spring.

J. O. Toland.





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